CLINICAL CALORIMETRY

SEVENTH PAPER

CALORIMETRIC OBSERVATIONS ON THE METABOLISM OF TYPHOID PATIENTS WITH AND WITHOUT FOOD *

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CONTENTS

PREVIOUS INVESTIGATIONS

In a previous communication[1] the respiratory metabolism of typhoid patients as determined by means of the small Benedict respiration apparatus was discussed in detail. The literature of the subject was also reviewed, making repetition here unnecessary. Following this earlier work it was possible to continue the study of the typhoid patients by using the respiration calorimeter of the Russell Sage Institute of Pathology in Bellevue Hospital. In the immediately preceding papers of the series[2] the calorimeter and the metabolism ward have been described in detail and data have been given in regard to the normal controls and the absorption of food in typhoid fever. The patients studied were all in the metabolism ward and the calorimeter experiments were conducted in the manner described in the paper on normal controls. In our previous work on the general effect of the high calory diet on respiratory metabolism it was difficult to control the nourishment of the patients so as to determine the basal metabolism and the quantitative effects of different foods. It was, however, pos-

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1. Coleman and DuBois: The Influence of the High Calory Diet on the Respiratory Exchanges in Typhoid Fever, The Archives Int. Med., 1914, xiv, 168.

2. Clinical Calorimetry, Papers 1 to 6, this number. Brief preliminary reports were published in Jour. Am. Med. Assn., 1914, lxiii, 827, and ibid., 1914, lxiii, 932.

sible to demonstrate that the heat production of typhoid patients on a liberal diet was practically the same as that of fasting patients.

Patients with fever have been studied before in various calorimeters. Isaac Ott[3] of Philadelphia as early as 1892 made observations on a patient with malaria using a rather simple type of calorimeter which required a plus correction of 16 per cent. Likatscheff and Avroroff[4] in 1902 made classical experiments on a similar case. In 1909 Benedict and Carpenter[5] studied a few cases of mercurial poisoning with fever in the Middletown calorimeter. An excellent summary of the literature is given in the Russian publication.[4] It is sufficient to say that the rise and fall of body temperature have been ascribed at various times to every possible combination of increase and decrease in heat production and heat elimination. The Russians used the Paschutin calorimeter in which the patient was kept for twenty-two hours, feeding herself and apparently moving about the chamber during the day whenever she felt inclined to do so. The heat elimination was measured in periods of two hours each and the body temperature was determined every two hours, apparently by means of a mercurial thermometer in the axilla. The CO_2 and water elimination were measured in two-hour periods but the oxygen consumption and consequently the respiratory quotient could only be determined by the change in body weight during twenty-two hours. This method seems to have given satisfactory results, since the quotients correspond to those usually found under similar conditions and calculation of the indirect calorimetry in the three experiments gives results which come within —6 per cent. +6 per cent. and +12 per cent. of the direct calorimetry. The Russians themselves calculated the total heat production by adding the calories stored in or lost from the body as the temperature rose and fell to the calories eliminated by means of radiation, conduction and vaporization. They came to the conclusion that the rise of body temperature was due to an increase in heat production. Benedict and Carpenter studied their fever patients under similar conditions, but determined the oxygen, CO_2 and the heat elimination in periods from two to six hours in length. If one takes the periods when their subjects

3. Ott, Isaac: The Modern Antipyretics, Ed. 2, Easton, Pa., 1892; Fever, Its Thermotaxis and Metabolism, New York, 1914.

4. Likatscheff and Avroroff: Investigations of Gaseous and Heat Exchange in Fevers. Reports of the Imperial Military Academy, St. Petersburg, 1902, v, parts 3 and 4. We are indebted to Dr. F. G. Benedict of the Carnegie Nutrition Laboratory for permission to consult his translation of this important work. Excellent abstracts in English have been published in a paper by A. I. Ringer (Physiology and Pathology of Fever, Am. Jour. Med. Sc., 1911, cxlii, 485) and in the monograph on Fever by Ott.

5. Benedict and Carpenter: Preliminary Observations on Metabolism During Fever, Am. Jour. Physiol., 1909, xxiv, 203.

had a body temperature of 38 C. or over and calculates the indirect calorimetry, using the oxygen and quotients, it is easy to determine the divergence of the direct from the indirect calorimetry. The percentage differences are as follows: +5. +10. —9 +9. +2.

METHODS USED

The present work with the calorimeter was undertaken to extend the previous observations and clear up some doubtful points which could be settled only by a most careful control of the diet and by a comparison of the direct and indirect calorimetry. The fact that it was impossible to bring typhoid patients into nitrogen equilibrium unless the diet greatly exceeded the heat production as calculated from the oxygen consumption, suggested the possibility that the method of calculating the indirect calorimetry might be incorrect. There remained also the old work on fever in which abnormally low respiratory quotients were obtained, leading several investigators to believe that the metabolism in fever was radically different from that in health. Finally, it was hoped that it would be possible to determine whether the rising body temperature was due to an increasing heat production or to a decreasing heat elimination.

The subjects studied were typhoid patients who entered Bellevue Hospital in 1913 and 1914. There was some selection of cases in an effort to obtain men in the early stages of the disease who were intelligent enough to cooperate. Most of the patients were taken to the metabolism ward so early in the disease that it was impossible to predict whether the fever would run a mild or severe course. Several patients were transferred from the First Medical Division through the kindness of Dr. Norrie and Dr. Miller to whom we are much indebted.

All of the patients were put on the high calory diet described in previous publications[6] and trained to take the large amounts of food. The very large amounts formerly given to some patients were not administered and the calories seldom exceeded 3,000 a day. An attempt was made to keep the food nitrogen at 15 grams. The stools exceeded two a day only on the occasions mentioned in the histories, and there was seldom abdominal distention. None of the patients was tubbed, although cold sponges were occasionally given to make the patient

6. Shaffer and Coleman: Protein Metabolism in Typhoid Fever, The Archives Int. Med., 1909, iv, 538-600; Coleman: Diet in Typhoid Fever, Jour. Am. Med. Assn., 1909, liii, 1145; The High Calory Diet in Typhoid Fever — A Study of One Hundred and Eleven Cases, Am. Jour. Med. Sc., 1912, cxliv, 659; DuBois: The Absorption of Food in Typhoid Fever, The Archives Int. Med., 1912, x, 177; Coleman: Weight Curves in Typhoid Fever, Am. Jour. Med. Sc., 1912, cxliv, 659; Diet and Metabolism in Fever, Trans. Fifteenth Internat. Cong. on Hyg. and Demog., 1912.

feel more comfortable when the temperature reached 104. Nervous symptoms were not prominent in any case, although one or two of them were mildly delirious for a few days. Most of the patients were cheerful throughout their illness and read the daily papers. It is estimated that their activity increased their metabolism about 10 per cent. above the basal level, although this figure is necessarily only an approximation.

CASE REPORTS

Case 1.—Morris S. (severe typhoid) tailor, English Hebrew of Russian extraction, 21 years old, admitted October 17, discharged January 30.

History.—Previous history unimportant; patient is not alcoholic. He landed from England Sept. 28, 1913. October 10 he began to suffer from pain in his abdomen, chest and back. On the thirteenth he had a nose bleed. Since the onset of symptoms he has had no appetite and has been constipated.

Physical Examination.—Patient is a well-nourished young man of small frame and short stature, being 164 cm. tall. There is slight cyanosis of lips and ears, the tongue is heavily coated, tonsils hypertrophied and congested. There is an occasional subcrepitant râle at the apex of the left lung. The spleen is palpable.

Blood taken October 18 gave a negative Widal test but developed a growth of typhoid bacilli. The spleen edge was felt 4 cm. below the costal margin and a few rose spots were present. October 24 the Widal was positive. The next day there were a few sibilant and sonorous sounds over the chest, clearing up by the twenty-seventh. The patient had been on a diet with high carbohydrate and low fat, and on October 23 and 24 had shown abdominal distention with about four liquid stools a day. The distention and diarrhea ceased when the fat was increased and the very large amounts of carbohydrate stopped. For the next month he had only one or two movements a day. October 30 he became a little irrational and his color was grayish, his pulse soft and very dicrotic. November 3 he was irrational in the calorimeter and wrote several notes about the animals which he saw in his hallucinations. The next day he was in much better condition, the pulse was stronger and his physical condition improved steadily.

November 16 the temperature began to rise after it had been practically normal for five days. He felt perfectly well and was bright and cheerful, in spite of a temperature of 104, until the evening of the eighteenth when he had a sharp pain in the right side of the abdomen. This disappeared the next day. This relapse was almost as severe as the original infection, but the patient was not quite so toxic and was never irrational. The temperature remained normal from December 7 to 17. From November 23 to 26 he had frothy stools but these became formed once more when the fat in the diet was increased.

December 17 a second relapse began and lasted until the 27th. During the period of rising temperature he was somewhat apathetic and suffered from headache and was fretful during the two days of high fever. His general condition remained excellent and he never realized that he was having a relapse. Following this, convalescence was rapid, since he had lost practically no weight during his illness. During the next year he reported at the hospital several times, always in excellent condition and five or ten pounds heavier than ever before in his life.

In December, 1914, he returned to the metabolism ward for two days, giving us the opportunity to determine his basal metabolism and the specific dynamic action of the protein meal.

This history is given in detail since Morris S. was placed in the calorimeter twenty-four times. He was an exceptional patient, in that he ate the prescribed diet practically every day and enjoyed the distinction of going in the calorimeter more often than his fellow patients. Nothing made him happier than the extra attention he received on calorimeter days, and as a result he did exactly what he was told to do. We were particularly fortunate in being able to determine the specific dynamic action of protein and the basal metabolism while he was in perfect health, a year after his infection.

Case 2.—Charles F. (severe typhoid), elevator constructor, born in New York, 24 years old, admitted November 4, discharged January 12.

History.—Lives in same house as his nephew Howard F., who has similar symptoms. On October 28 he began to suffer from anorexia, malaise and headache. On November 3 he had a nose bleed. He did not take to bed until admitted to the hospital.

Physical Examination.—Fairly well-nourished young man of medium frame, 166 cm. tall. He is moderately prostrated; there are several rose spots and the spleen edge is palpable 4 cm. below the costal margin.

Blood taken the day after admission gave a positive Widal test and showed a growth of typhoid bacilli. November 7 and again on the eighth he had a small intestinal hemorrhage of about 200 c.c. His general condition remained fair; he was rational and the toxemia not marked. He was given a daily sponge for his high temperature. At this time he took his food very badly and after the hemorrhages ceased it was impossible to give even 2,000 calories. November 14 to 17 he had a severe follicular tonsillitis and his toxemia was marked. Rose spots appeared in crops. On the nineteenth he had a hemorrhage of about 250 c.c. and was very toxic and apathetic for the next week. His pulse was very soft, systolic blood pressure being 95 mm. mercury. By December 3 the temperature was normal, he was much improved and was reading the paper every day. Convalescence was rapid. Throughout the disease he had one formed stool each day.

This patient was very intelligent and was anxious to help us in every way possible but his digestion made it difficult for him to take the food. He was very quiet while in the calorimeter.

Case 3.—Howard F. (typhoid fever of moderate severity), schoolboy, born in New York, 12 years old, admitted November 4; discharged January 22.

History.—Lives in the same house as his uncle, Charles F. He was perfectly well until October 26 when he had a severe headache. On the twenty-eighth he felt so sick that he took to bed. The next day he had a chill; vomited. He had nose bleed on the thirty-first and on the day of admission.

Physical Examination.—Patient is a tall, slender boy who has not yet reached the age of puberty; height 160 cm.; the cheeks are flushed and he looks acutely ill. Heart apex in the fourth space 8.5 cm. to the left of the midline. There are several rose spots on the abdomen; the spleen is not palpable.

On November 14 the blood culture showed typhoid bacilli. November 12 showers of subcrepitant râles appeared at the left base and the next day sibilant and sonorous sounds were heard all over the chest. His general condition was good, and although he was very apathetic, he was perfectly rational. He took his food very poorly, vomiting often. By the seventeenth he was very thin, quite toxic, very drowsy but rational. The pulse was soft but of fair quality.

The sibilant and sonorous sounds persisted until the twenty-fourth, by which time the temperature was falling, the appetite much better and the patient able to read the paper. Convalescence progressed rather slowly. On December 10 he passed two ascarides. The heart action was rapid on exertion and on the eighteenth the apex was in the fourth space 9.5 cm. from the midline. He left the hospital in good condition. Throughout his illness he had one stool a day.

The boy was very intelligent and made a good subject for the calorimeter.

CASE 4.—Karl S. (typhoid fever of moderate severity), stoker on steamer to South America, German, 24 years old, admitted December 29; discharged Feb. 18.

History.—Returning on a voyage from Brazil he landed at San Domingo for a few days, reaching New York December 20. Two days later he began to suffer from headache, weakness, lassitude, anorexia and nausea. On the twenty-fourth he began to have daily chills.

Physical Examination.—One hundred and sixty-eight cm. tall, muscular and well nourished. His face is flushed and he looks stuporous. No spots, spleen not palpable. Blood taken the day after admission gave a negative Widal but positive growth of typhoid bacilli. January 1 rose spots appeared and the spleen became palpable. On the third he was prostrated, apathetic and showed slight subsultus tendinum. The pulse was soft and dicrotic and the abdomen distended. When carbohydrates were pushed too high he became distended, but this trouble disappeared when the amounts were decreased. By January 7 he was anxious about his condition and easily frightened. On the tenth his condition was satisfactory and by the twenty-sixth he was afebrile and was reading and studying every day. He was very hungry during his rapid convalescence. February 14 he developed tonsillitis. The temperature rose to 101 and the pulse became rapid. He did not feel sick and resented being confined to bed. On the seventeenth he became insubordinate and was discharged from the hospital. Two weeks later he returned on a visit in good condition.

This patient was a rough sailor of sullen disposition and made a rather restless subject for the calorimeter. During most of the observations on this man one of the water thermometers was being repaired and the method of direct calorimetry could not be used.

CASE 5.—Thomas B. (typhoid fever, mild; followed by acute fibrinous pleurisy). Laborer, Irish, 60 years old, admitted October 2, discharged December 8.

History.—Moderately alcoholic. About September 18 began to suffer from malaise, anorexia and fever.

Physical Examination.—Large well-nourished man, who looks acutely ill. He is apathetic and slightly cyanotic.

Blood taken the day of admission gave a positive Widal and showed a growth of typhoid bacilli. Many rose spots appeared but the spleen was never palpable. He took his food well and was never very ill. From October 22 to November 6 the temperature was normal. Then it rose gradually to 104 and fell slowly reaching normal on the twenty-sixth. During this time he developed dulness, bronchial voice and breathing at the left base, the signs being attributed to a pleurisy rather than pneumonia. He made a rapid convalescence.

CASE 6.—Richard T. (mild typhoid). Mulatto boy, born in New York, 14 years old, admitted October 6, discharged November 24.

History.—About September 30 began to suffer from headache, weakness, constipation and occasional abdominal pains.

Physical Examination.—Well nourished active boy who has not yet reached puberty. There are a few rose spots and the spleen is palpable.

The day after admission the blood culture gave a positive Widal and showed a growth of typhoid bacilli. The disease ran a mild and uneventful course, in spite of high evening temperatures, until October 25, when he developed slight pain and tenderness over the gall bladder, lasting two days. The temperature reached normal October 29, but rose again in a mild relapse lasting till November 6. Convalescence was rapid.

The boy was somewhat mischievous and was very active throughout his stay in the hospital. While in the calorimeter he spent most of his time looking out of the window and was not as quiet as most of the patients.

Case 7.—Anton K. (mild typhoid), factory worker, Austrian, 18 years old, admitted September 30, discharged November 18.

History.—September 22 he began to have daily chills and fever, lost his appetite, felt exhausted and had severe pains in the epigastrium.

Physical Examination.—This showed a well-nourished man, apathetic and acutely ill. Typhoid bacilli were found in the blood. At the height of his fever he was prostrated and developed slight subsultus tendinum. He took his food well and was in good condition on October 16, the first day of normal temperature.

Case 8.—Rose G. (severe typhoid), born in New York, 12 years old; admitted September 19, discharged November 26.

History.—Menstruation has not yet begun. The girl is tall and very thin and is somewhat deficient mentally. She went through a severe course of typhoid, with marked emaciation. Blood culture showed typhoid bacilli. During the disease she had râles at both bases and developed bed sores because she had all her life been incontinent of urine. Temperature reached normal October 29, and she was up and about on November 17. During convalescence she ate enormous amounts of food, with very slight gain in weight. She was not in the metabolism ward and exact figures for the food were not obtainable, but it seemed as if the discrepancy between food and gain in weight could be accounted for only by a greatly increased metabolism. The first hour she was in the calorimeter she was quiet, but during the second hour she voided in bed and began to cry, making it necessary to end the observation.

Case 9.—Edward B. (severe typhoid), longshoreman, born in Ireland, 36 years old; admitted October 3, 1914, discharged February, 1915.

History.—He remembers no previous illnesses. October 1 he began to suffer from headache, pains all over the body and abdominal cramps, with diarrhea and three to four stools a day. He had no nausea and the appetite was good.

Physical Examination.—Well-nourished man of medium frame, fairly muscular. He is dull and apathetic and moderately prostrated. The heart is rapid, not enlarged, the lungs are clear, abdomen soft, spleen palpable. There are a few rose spots.

The blood on October 4 was sterile, but gave a positive Widal test. On the sixth he was very drowsy; by the tenth he was comfortable and eating well. October 13 the temperature had again risen, the pulse rate had jumped to 120 and the quality of the pulse was poor. On the twentieth he was much better and was taking his food well, but the abdomen was slightly distended. By November 1 the temperature was almost normal and the general condition excellent in spite of a small rapid weak pulse. By November 7 the temperature was up again, and he was beginning to feel indisposed. The appetite was poor and the pulse rate between 138 and 148. During the next few days the pulse was very rapid, slightly irregular, and very weak. He was very toxic but was rational except for short periods when the mind was a little hazy. November 16 he had a small hemorrhage with a short period of collapse, but recovered quickly. His condition improved steadily until December 3 when the temperature rose once more and he suffered from a moderately severe relapse, lasting until December 21. Following this was a period of three days of normal temperature and then a fourth relapse, very mild in character lasting only three days. During the whole period of his illness his nutrition remained good; he was always cheerful and read the newspaper almost every day.

CASE 10.—John K. (typhoid fever, mild), deck hand, Polish, aged 35; admitted Dec. 12, 1914, discharged Jan. 27, 1915.

History.—December 2, began to suffer from malaise. December 5 had a severe chill and took to bed; since then has had chills almost every day. Has had continuous headache, has vomited frequently and has been constipated.

Physical Examination.—Tall and thin, fairly muscular. Tongue dry, coated, fissured. Heart and lungs clear, spleen palpable, many rose spots.

December 12, the blood culture was sterile but the Widal positive. On the thirteenth he had his last chill, on the sixteenth he was apathetic and prostrated, pulse was slow and dicrotic, there was a patch of herpes on the upper lip. As the temperature fell during the next few days his condition improved rapidly, but the apathy remained until the temperature was normal, and he was unusually quiet, remaining almost motionless all day long. Convalescence was rapid.

DISCUSSION OF RESULTS

Law of Conservation of Energy in Fever.—The law of conservation of energy has been shown to apply to the lower animals, to normal men and to babies, and has been discussed in the previous paper (Paper 6) on normal controls, in which it was demonstrated that with normal men a satisfactory agreement between the direct and indirect calorimetry could be obtained in periods as short as one hour. While there are few who doubt that the law applies to men with fever, it may not be superfluous to bring forward proof.

An agreement of the direct and indirect calorimetry within the limits of experimental error indicates that protein, fat and carbohydrate are oxidized to the same or approximately the same end products as in health and that in the oxidation they give off the standard amounts of heat. The method of calculating the indirect calorimetry depends on the assumption that the calories furnished by each gram of protein, fat and carbohydrate correspond to the standard figures of Loewy,[7] protein 4.32, fat 9.46, starch 4.18. The results obtained by the method of direct calorimetry, which is dependent only on fundamental laws of physics, must remain the standard method of comparison when considering large groups of experiments. Once the agreement has been proved for the group, the method of indirect calorimetry is preferable for individual experiments as has been shown in previous papers on account of the technical difficulty of the method of direct calorimetry in short periods.

Table 1 gives a summary of the percentage divergence of the direct and indirect calorimetry in all the experiments on the typhoid patients,

7. Loewy: Der respiratorische und der Gesamtumsatz, Oppenheimer's Handb. der Biochem, 1911, iv, 280.

the great majority of them being three hours long. In all cases the indirect method was used as a standard. If we consider the total measurement of 12,822 calories, we find the direct method, as calculated from the rectal temperature, gives results only 2.2 per cent. lower than the indirect. In almost half of the experiments the body temperature was measured by a thermometer of two units strapped on the thorax in the region of the apex of the heart and just below the right nipple, each unit being covered by a pad of cotton about 15 cm. square and 4 cm. thick. The rectal thermometer was inserted about 12 cm. beyond the sphincter. In a previous paper attention has been called to the fact that in these typhoid cases in which both methods were tried

TABLE 1.—Percentage Divergence of Direct from Indirect Calorimetry in the Individual Experiments

Percentage Divergence	Number of Experiments Falling in Each Group					
	According to Rectal Temperature			According to Surface Temperature		
	+ Divergence	– Divergence	Total	+	—	Total
0- 5............	17	22	39	11	7	18
6-10............	3	15	18	2	7	9
11-17............	1	3	4	0	1	1
Total.......	..	..	61	..	..	28
Average Error..	..	..	±4.9%	..	..	±4.0%

	Indirect	Direct*	Divergence
			%
Total calories measured in all experiments...........	12,822.03	12,539.67	—2.2
Excluding first periods................................	8,470.93	8,488.97	+0.2
Calories measured in febrile experiments excluding all first periods	5,720.21	5,583.55	—2.4

* According to rectal temperature.

slightly better results were obtained by using the surface thermometers to give the temperature changes of the body than by using the rectal. In the long run the rectal thermometer is the more reliable, since it is not so easily displaced by bodily movement, but enough evidence has been accumulated to show that the rectal temperature does not always change in the same degree and not always in the same direction as the average body change. As the body cools off there may be a relative increase in the heat near the surface of the body, since this is the place that most of the heat is dissipated. The opposite takes place when the temperature is rising. On account of the rapid circulation of blood there is, of course, a tendency for the temperature curves of the different parts of the body to follow the deep temperature as measured in the rectum.

In the sixty-one experiments in which the rectal temperature was measured the average divergence of the indirect calorimetry from the direct calorimetry (as based on the rectal temperature) is only ± 4.9 per cent. In twenty-eight of these experiments it was possible to base the calculations on the changes in the surface temperature, with an average divergence of 4.0 per cent. using this latter method. This divergence of 4 or 5 per cent. is not more than one often finds among normal controls, since the technic is difficult even with trained subjects. The reason for the total minus error of 2.2 per cent. is not clear. The largest part of this error frequently falls in the first hour, especially in patients with fever, and we have been led to suspect that the subject continues to give out heat to the wooden bed frame and to the bedding even after he has been on the bed for an hour. If we excluded from our calculations the first periods, while the calorimeter is still coming into thermal equilibrium, we find that the direct and indirect methods agree within 0.2 per cent. If we consider only those experiments made during the febrile period, we find a larger proportion show a minus error in the direct calorimetry than when we take all the experiments put together. Excluding the first hours of each experiment, however, the direct calorimetry gives a total only 2.4 per cent. lower than the indirect. The difference is so small that it might be found in a group of normal controls. It may be entirely accounted for by the difficulty in measuring the average body temperature during fever.

Basal Metabolism in Typhoid Fever.—In Paper 4 of this series the reasons have been given for the selection of the standard of the average normal basal metabolism. The figure of 34.7 calories per square meter per hour as based on Meeh's formula has been used in all the calculations. It was impossible to use the new surface formula as a standard since this was not devised until most of the typhoid work had been completed.

The relationship of the basal metabolism of the typhoid patients in the various stages of the disease to the normal is shown in Table 2. This corresponds in a striking manner with the averages of the fasting typhoid patients investigated by Kraus, Svenson, Grafe and Rolly and collected by us in a previous publication.[1] It is evident from the general trend of the results that the total metabolism increases and falls in a curve roughly parallel with the body temperature, and that the period when it drops below normal in many patients corresponds with the period of subnormal temperature which occurs so often in the first week of convalescence. From a study of the results obtained by the calorimeter and by various smaller types of respiration apparatus, it is apparent that there is considerable variation in the heat production of different patients and the same patient at different stages of the fever. While we can state that the average increase in typhoid fever is approximately 40 per cent., we must remember that figures over 50 per cent. are frequently encountered. This should make us cautious in drawing too many deductions from feeding experiments unaccompanied by determinations of the respiratory metabolism. It should also be remembered that typhoid fever is the only fever which has been thoroughly investigated and that if variations occur in this one disease the variations may be quite different in other febrile diseases such as erysipelas, pneumonia, puerperal fever, etc.

TABLE 2.—Basal Metabolism, According to Periods of Typhoid Fever

Periods	Number of Patients	Number of Observations	Average Per Cent. Rise Above Average Normal 34.7 Cal. per Sq. M.	Average Respiratory Quotient
Ascending temperature	2	2	+37	0.79
Continued temperature	5	7	+42	0.77
Early steep curve	3	4	+26	0.82
Late steep curve	3	3	+16	0.82
Relapse—				
Ascending temperature	2	3	+25	0.82
Continued temperature	2	2	+51	0.76
Early steep curve	2	4	+36	0.78
Late steep curve	1	1	+16	0.79
Convalescence—				
First week	3	4	— 2	0.91
Second week	3	5	+ 6	0.88
Third week	1	1	+17	0.81
Fourth week	2	2	+15	0.86
Fifth week	2	2	+ 4	0.81

Benedict and his co-workers in all their recent publications have drawn attention to the fact that pulse rate and total metabolism show curves which are roughly parallel. As might be expected this parallelism is not as apparent in typhoid fever as in the conditions they have studied. Typhoid is characterized by a slow pulse in the first two weeks when the metabolism is high. The experiments here reported do not show any striking agreement in the rise and fall of the two curves.

The Specific Dynamic Action of Food.—When studying the effects of the high calory diet in typhoid fever with the small Benedict respiration apparatus, the writers noted the fact that the metabolism of liberally fed typhoid patients was scarcely raised above the metabolism of fasting typhoid patients. The conclusion was drawn that food exhibits little or no specific dynamic action in typhoid fever. One of the chief objects of the present research was to study this striking phenomenon more closely, inasmuch as some observers, among them Von Noorden,[8] have stated that the specific dynamic action of food was increased in fever, exophthalmic goiter and several other conditions.

We have seldom kept typhoid patients in the calorimeter for periods exceeding three or four hours. After this length of time the patients often become restless and bored, making the results unreliable. This

TABLE 3.—Specific Dynamic Action of Protein and Carbohydrate in Health, Fever and Convalescence

Subjects	Number of Experiments	Average Gm. of Nitrogen or Glucose in Food	Average Gm. Food per Kg. Body Weight Nitrogen or Glucose	Average Per Cent. Rise in Metabolism
Protein meal				
Two normal men*	2	10.1	0.147	9.3
Four febrile patients	6	8.6	0.174	4.5
Four convalescents	5	10.2	0.217	16.6
Commercial glucose				
Three normal men*	3	115.0	1.6	9.1
Two febrile patients	4	115.0	2.2	1.0
Three convalescents	3	115.0	2.7	9.8

* Since the completion of Paper 4 two more normal controls have been given the test meals. Morris S. on Dec. 18, 1914, showed a rise of 6.5 per cent. after a meal containing 9.6 gm. N.; Albert G. on Jan. 6, 1915, showed an increase of 9.0 per cent. in his metabolism after 115 gm. commercial glucose.

has made it impossible to determine the basal metabolism in a two hour experiment and follow it immediately by a three or four hour experiment to find out the effect of food. Moreover, in such a long period the temperature might change several degrees, making the results difficult of interpretation. In the case of normal controls, the basal metabolism is so uniform from day to day that very accurate results can be obtained by determining the basal metabolism and the metabolism after food on different days. In fever the change in the level of metabolism from day to day makes the results less accurate but the error will be small if certain precautions are taken. The level of basal heat production changes in a fairly gradual and uniform curve and

8. Von Noorden: New Aspects of Diabetes, New York, E. B. Treat & Co., 1912, p. 20.

there is but a small change in twenty-four hours unless the temperature or the general condition of the patient changes markedly. For this reason the effect of a given meal has been determined sometimes the day before, sometimes the day after and sometimes the day between basal experiments. The protein meal was given six times in the febrile period and the glucose meal four times. It is against the laws of probability that the basal metabolism should take a sudden change in the same direction on all these days.

The fact that the average amount of protein given in the febrile period was less than that given in health was due to the poor appetite of the patients at the height of the disease. Even in health and in

TABLE 4.—Chart Showing Negative Nitrogen Balances in Typhoid Patients who Receive Food Calories in Excess of Calculated Heat Production

Patient	Dates or Days of Disease Inclusive	Days in Period	Range of Maximum Temperature, Degrees F.	Calculated Heat Production, Cal.*	Food Calories*	Food N, Gm.*	Nitrogen Balance Gm.*
Morris S.	Oct. 23-Nov. 3	12	102.8-104.6	2,266	2,863	16.4	—4.4
	Dec. 19-24	6	101.9-105.1	2,085	2,989	13.2	—2.4
Charles F.	Nov. 28-30	3	101.2-103.4	1,752	2,458	12.0	—4.6
Karl S. ...	Jan. 12-18	7	101.0-105.0	2,197	2,985	16.1	—3.2
	Jan. 19-22	4	98.8- 99.0	1,678	2,819	14.6	—1.9
John K....	Jan. 15-20	6	103.2-104.0	2,568			
	Days of Disease						
Frank W.†	11-14	4	104.0-105.4	2,200	2,250	11.3	—5.0
	15-19	5	103.0-104.0	2,238	3,320	15.3	—3.3
	20-23	4	101.0-103.6	2,054	2,362	15.9	—1.5

* Figures given are averages for twenty-four hours.
† Taken from Coleman and Du Bois.[1]

convalescence the meal is a large one, containing almost as much protein as most people consume in a day. We must remember also that the normal controls weighed 75 and 63 kg. when they took this meal and that the typhoid patients weighed 51, 58, 35, and 54 kg., respectively. As is shown in Table 3 the controls received less nitrogen per unit of body weight than the fever patients. We can therefore state that protein and glucose exhibit a much smaller specific dynamic action in typhoid fever than in health, while in convalescence from the disease the specific dynamic action seems to be greater than normal. In the case of glucose there was practically no specific dynamic action in fever, and in the case of Morris S. the specific dynamic action of the protein was very slight.

The cause for this phenomenon has not yet been definitely ascertained but the most plausible theory was stated by Dr. Graham Lusk[9] in the discussion on the symposium on nutrition at Atlantic City in 1914. He called attention to the well known fact that if the metabolism be increased by lowering the environmental temperature there may be

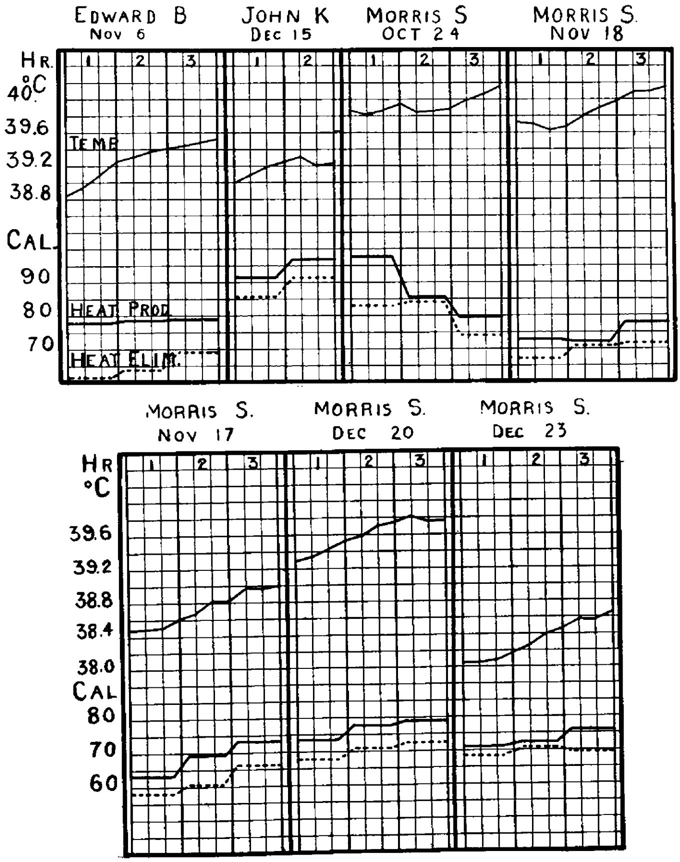

Chart 1.—Curves showing the relationship of heat production and heat elimination in fever. Rising temperature. The uppermost line shows the rectal temperature as measured every twenty minutes. The heavy continued line represents the heat production in hourly periods as determined by the method of indirect calorimetry. The dotted line gives the heat elimination as determined by the measurement of the calories of radiation, conduction and vaporization. The difference between the levels of these two lines represents the heat stored in the body as the temperature rises. Note the fact that in every case except one the heat elimination increases with a rising temperature.

no specific dynamic action as usually induced by ingested food. In like manner if the metabolism be raised in fever, food ingestion may cause no increase. He also stated that since protein metabolism in fever

9. Lusk: Jour. Am. Med. Assn., 1914, lxiii, 831, foot of page.

can never be reduced to as low a level as is present in the normal organism, therefore protein ingestion in fever often merely serves to replace the protein already breaking up in increased quantity, and such protein ingestion would not then serve to increase the heat production.

The Regulation of Body Temperature.—The study of the regulation of body temperature is one that demands the utmost accuracy of technic. The question at issue is whether a rise in temperature is due to an increase in heat production or a decrease in heat elimination. Previous investigators have tried to solve this problem on data obtained from the direct calorimetry alone, or from the indirect calorimetry accompanied by measurements of body temperature. In either of these two methods the whole calculation would depend on the exact

Chart 2.—Curves showing the relationship of heat production and heat elimination in fever. (See legend Chart 1.) Temperature level or falling. In the last two experiments it will be noted that the heat elimination rises above the production.

measurement of the average change in body temperature, the exact calculation of specific heat of the body and the amount of heat stored in or lost from the body. It has been shown in this and preceding papers that these measurements and calculations are the weakest points in the science of calorimetry and it is only very recently that the technic has been so developed that investigators have attempted a comparison of the methods of direct and indirect calorimetry in periods shorter than six to twelve hours, periods obviously too long for the study of the problem in question. If, in a period of experimentation, the results obtained by the method of indirect calorimetry and by the method of direct calorimetry, using either the rectal or the surface temperature, do not agree within 5 per cent., we must suspect some error, probably in the measurement of the average body temperature change. For this reason we have eliminated from the discussion all experiments in which the two methods do not agree within 5 per cent. It is also preferable to eliminate all experiments after the taking of food and all experiments in which the subject was not quiet. This gives us eleven experiments during the febrile period in which the technic left nothing to be desired.

In Chart 1 are grouped those experiments in which there was a rising body temperature. The dotted line shows the total heat eliminated from the body by means of radiation, conduction and vaporization. The continued line shows the heat production as determined by the method of indirect calorimetry, which does not use a single factor that affects the dotted line. With a rising body temperature the heat production within the body must be greater than the elimination to provide for the storage of heat in the tissues. Many are of the opinion that the rise in temperature is chiefly due to a decrease in the heat elimination. This we find to be the case only in the last hour of one of the seven observations, there being a sharp drop in both heat production and elimination towards the end of the experiment on Morris S. on October 24. In all the other periods the rising temperature was accompanied by an increasing heat production which outweighed the increasing heat elimination.

In Chart 2 which shows periods in which the body temperatures were fairly level the production and elimination were about equal and constant. In the two observations with falling temperature the heat production remained fairly level while the elimination was increased.

Heat Production, Weight and Nitrogen Equilibrium.—In the cases here studied it is possible to make a comparison of the caloric intake and the caloric output. The intake consists of the calories of the food. The output is made up of many factors, but principally of calories lost by radiation, conduction and the evaporation of water. The first and most important consideration is the determination of the basal heat production as measured by the methods of direct and indirect calorimetry. As has been shown above, the two methods agree within 2 per cent. The actual heat production during the different hours of the day can depart from the basal as a result of various factors. We have shown above that the ingestion of large amounts of food causes but a slight increase in metabolism, averaging less than 5 per cent. in the case of protein and only 1 per cent. in the case of carbohydrate. These increases may be considered the maxima since the amounts of foods given were the largest the patient could take and the hours of the observation were the hours of the greatest specific dynamic action. The exact percentage rise caused by the stimulation of the food taken during the whole day is problematical but may be estimated as about 3 per cent. The percentage of calories lost in the feces has been studied in two previous papers and has been found to be practically normal. The calories lost as urea and in the feces are taken into consideration in the calculation of the fuel values of the food. In the one case in which there was alimentary glycosuria (Frank W.),[1] the calories lost as dextrose have been subtracted from the intake. In a previous paper the writers have discussed the evidence against an abnormal loss of partially oxidized carbon compounds in the urine and have come to the conclusion that this factor is negligible. The entire absence of abnormal respiratory quotients supports this view. The lowest quotient found was 0.72, the highest 1.04, obtained respectively during fasting and high carbohydrate ingestion, and thus exhibiting entirely normal relations.

The most uncertain factor is the variation in heat production caused by changes in the muscular activity. It is quite possible that a patient who is very delirious and very restless might produce twice as many calories as when quiet. The total heat production of such patients could be determined only by the Middletown type of experiment in which the subject was kept in a respiration calorimeter for days at a time. Such experiments are obviously impossible in typhoid fever. The question remains as to whether we obtain a fair sample of the day's metabolism by making two or three observations a week between the hours of 11 in the morning and 2 or 3 o'clock in the afternoon. This period includes some of the morning hours when the metabolism is said to be low and some of the afternoon hours when it is said to be high. During the experiment the activity of the patient has been almost the same as the activity observed in the ward during the greater part of the day between the hours of 5 in the morning and 8 in the evening. In the calorimeter the subjects are allowed to turn from side to side several times during the hour and they shift their position often enough to make themselves comfortable, which is exactly what they do in their beds in the ward. Part of the time they doze and part of the time they are awake and are looking out of the calorimeter window. In the ward they are kept flat in bed and are never allowed to sit up until the temperature has been normal for several days. They are never given cold tubs and hardly ever given cold sponges. Their food is served on trays and they help themselves with a minimum of exertion. In the morning the nurse gives each patient an enema, sponges

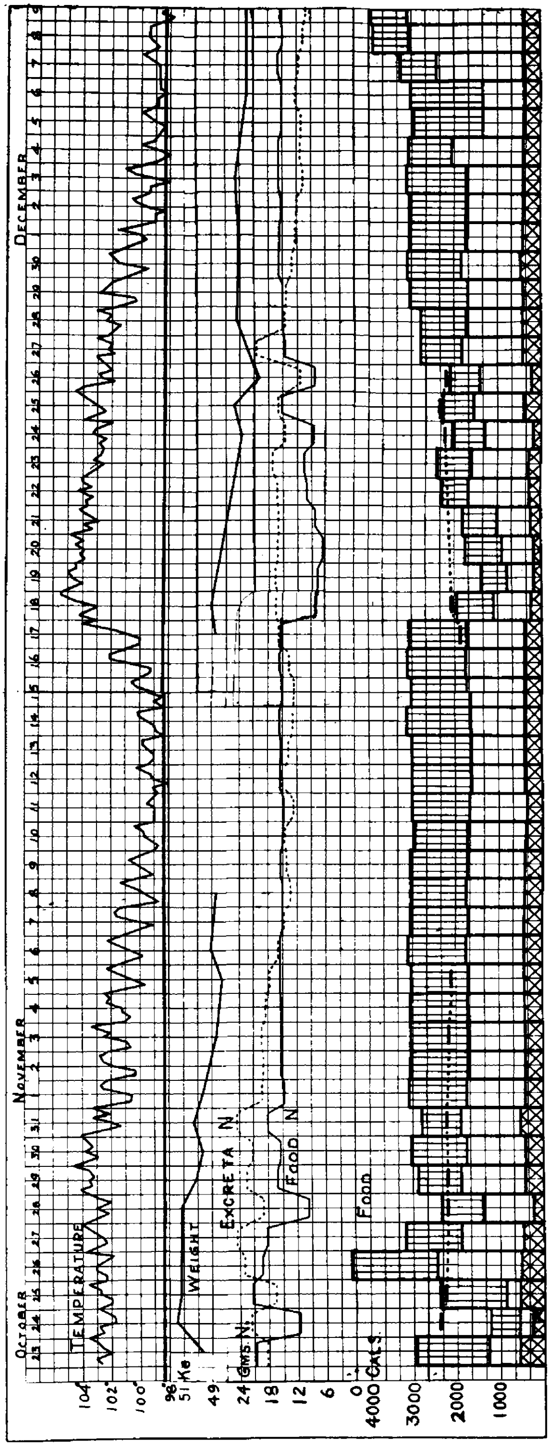

Chart 3.—Part 1

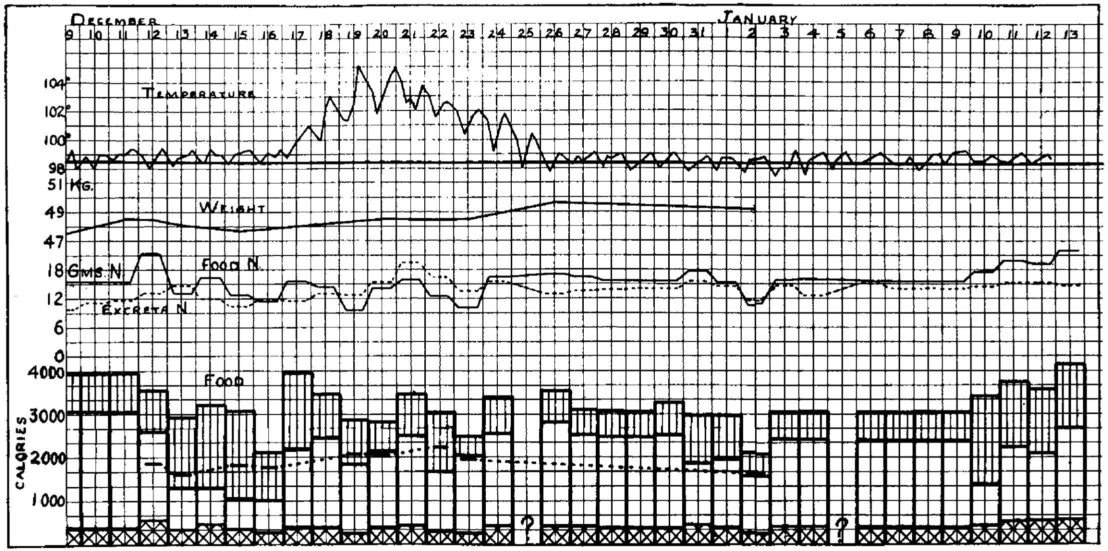

Chart 3.—Part 2

Chart 3.—Morris S.—Temperature, body weight. Food nitrogen, continuous line; excreta nitrogen, dotted line. At the base of the chart, columns representing total calories of food. Protein calories, crossed diagonals — fat calories, blank — carbohydrate calories, vertical lines. The dot-dash line represents the estimated heat production in calories for twenty-four hours. The dashes are placed on days of the observations in the calorimeter. Note that the calories of the food exceed the estimated heat production except for a period during the first relapse. Food was not measured on December 25th and January 5th.

him off with warm water, slides him from his bed to the weighing platform, makes up his bed and slides him back again. During the rest of the day he is seldom disturbed and he spends his time dozing, reading or talking with his neighbors. A few of the patients have been mildly irrational for a few days at a time and such occurrences have been noted in detail in the histories. Subsultus tendinum and jactitation have rarely been observed. On the other hand, there must be a reduction of the metabolism at night since the patients sleep soundly and are seldom disturbed. In a previous paper we have estimated that the bodily activity increases the metabolism during the whole day to an average of 10 per cent. above its basal metabolism. Since that time we have had the opportunity of making two observations on patients who were irrational and restless. November 3 Morris S. was in the calorimeter for three hours. During the first hour he was unusually quiet, during the second hour he was restless and tossed about the bed, during the third hour he was evidently irrational, tossed about and wrote three or four long notes which he held up to the calorimeter window to tell us about the animals that were biting him with their sharp teeth.

In spite of this unusual activity his metabolism during the three hour period was only 43 per cent. above the normal and was only 5 per cent. higher than during the quiet basal observation made two days later, when the temperature was lower. Edward B. on Nov. 10, 1914, was in the calorimeter with a temperature of 40.3 C., and during the second and third hours was restless and mildly irrational. His heat production was only 51 per cent. above the average normal. These two observations, which are fair samples of the severest symptoms observed in the typhoid patients presented in this paper, do not indicate any unusual degree of increase of heat production from the moderate activity. There may be an uneconomical expenditure of energy in typhoid in the performance of a certain task but even so the total expenditure is not great in these cases. It is hoped that at a later date the question of muscular efficiency in fever may be solved by having typhoid patients and normal controls do a stated amount of work on an ergometer while in the calorimeter.

A detailed consideration of all the factors is of importance when one attempts to draw conclusions from a discrepancy between the calculated intake and the calculated output. It is necessary to consider the possible errors in the various determinations and it is necessary to select somewhat arbitrary average percentages for the various factors. The measurement of the food intake is unusually accurate. Most of the foods such as cereals, bread, sugars, egg white and egg yolk, butter and crackers vary but slightly from the samples analyzed. The other foods given, such as milk, cream, and dried apples are not subject to large enough variations to affect the results. Foods subject to significant variations are carefully avoided.

The methods of preparation and weighing have been described in another paper and they are believed to be accurate within 2 per cent. It is doubtful if this error combined with the error in the variation of the individual foods exceeds plus or minus 5 per cent. and there is no factor to throw the error on one side of the scale more often than on the other. The heat production of the patients as determined by the method of indirect calorimetry is not subject to an error of more than 1 or 2 per cent. on the average, although it is possible that some individual observations may show an error of 5 per cent. The collection of the twenty-four hour specimens of urine and the estimation of

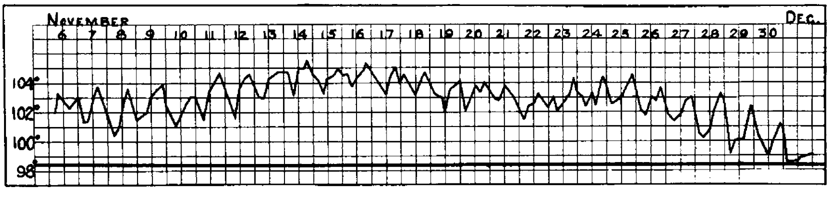

Chart 4.—Charles F. Temperature curve.

the nitrogen are so carefully controlled by duplicate analyses and checks in the collection of specimens and in the calculations that there is no chance for an error greater than 1 per cent. In the cases in which the feces were not analyzed the method of estimating the feces nitrogen as 10 per cent. of the food nitrogen gives a plus or minus error of less than half a gram a day while there is possibly as great an error in the fact that we do not take into account the nitrogen losses through the skin.

In order to estimate the caloric output of typhoid patients on whom respiration experiments were made, one can add to the basal metabolism on average 3 per cent. for the specific dynamic action of the food and 10 per cent. for muscular activity. We can, therefore, calculate with reasonable accuracy the heat production for the day by adding 13 per cent. to the figures obtained in the febrile basal experiments and 10 per cent. to the figures obtained in the experiments after food. In the cases in which several observations were made it seems fair to plot a smooth curve and consider that the heat production of the non-experimental days was the same as on the days in which actual determinations were made.

If we look now at Table 4 and Charts (3), (6) and (8), it becomes evident that three of the patients reported in this paper and one reported in a previous paper[1] showed a distinct negative nitrogen balance when they were receiving considerably more calories than were sufficient to cover the calculated heat production. A glance at the food charts will show that the typhoid patients were given 12 to 16 grams of nitrogen a day and that the proportions of fat and carbohydrate were well balanced. The only criticism of the manner of feeding is that on the days of the basal determinations it was necessary for the patient to fast sixteen to twenty hours. One might expect a slight negative nitrogen balance at such times, but this should be offset by a positive balance the next day. As a matter of fact the negative balance is not much greater on the experi-

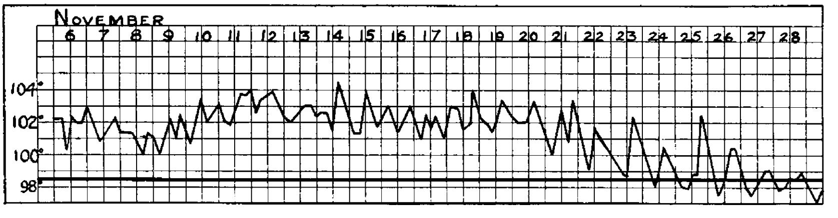

Chart 5.—Howard F. Temperature curve.

mental days. Moreover, as was pointed out in the previous paper, many patients who have not been the subject of respiration experiments have shown a persistent negative nitrogen balance on a diet much greater than the estimated heat production and have not come into nitrogen equilibrium until the theoretical requirement was exceeded by from 50 to 110 per cent.

In another place[1] when touching on this subject we referred to the possibility of a storage of fat while there was a negative nitrogen balance and loss of body weight. The body weight is notoriously a poor index of gain or loss of body tissue except in long periods of observation. The body changes its content of water so easily and so rapidly with changing diets and changing periods of the disease that it would be very easy to store 1 or 2 kilograms of fat without noticeable effect on the weight. We must remember that 1 kilogram of fat represents about 9,300 calories. Even without assuming a change in the water concentration of the body, it is possible to account for the storage of the excess calories. In the tables one can find several periods of almost constant body weight when the patient was losing nitrogen. If we consider that for every 3 grams of nitrogen lost the patient loses about 100 grams of muscle tissue, it is possible to calculate the total muscle tissue lost. If this were replaced by fat the weight would remain constant and the storage of the excess calories could easily be accounted for. For example, Morris S. between October 23 and November 3 lost about 1,770 grams of muscle tissue, which could be replaced by enough fat to represent 15,900 calories.

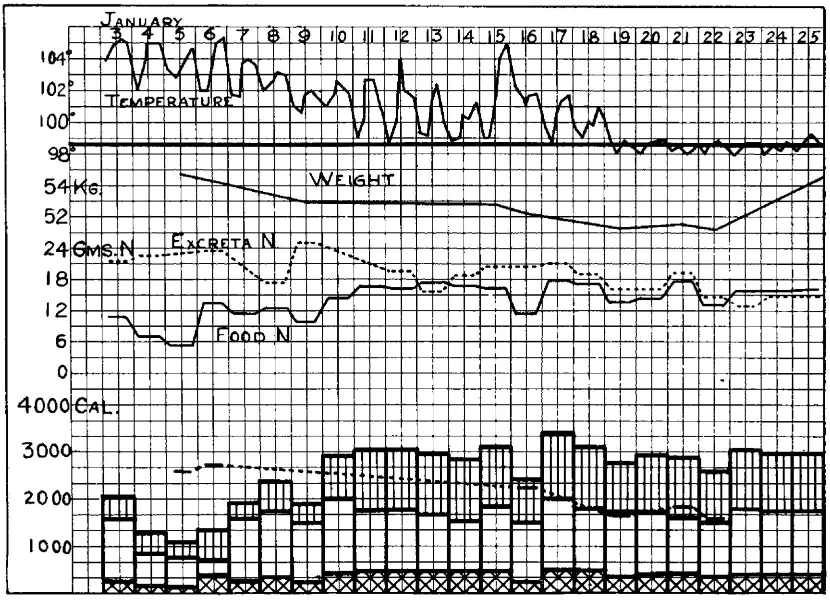

Chart 6.—Karl S. Temperature and body weight. Food nitrogen, continuous line; excreta nitrogen, dotted line. The columns at base represent calories in food. Protein calories crossed diagonals, fat calories blank, carbohydrate calories vertical lines. Dot-dash line represents the estimated heat production in calories for twenty-four hours, dashes being placed on the days of the calorimeter observations. Note the negative balance during the last days of the fever when the patient was receiving in food more calories than the estimated heat production.

In none of the cases were the protein and carbohydrate calories together sufficient to cover the heat production, so it is not necessary to assume the transformation of carbohydrate into fat, although we have shown that this is possible during fever in one patient[1] (Salvatore L.).

The Toxic Destruction of Protein.—The proof of the fact that typhoid patients show a negative nitrogen balance on a diet which furnishes more calories than the heat production, is perhaps the most

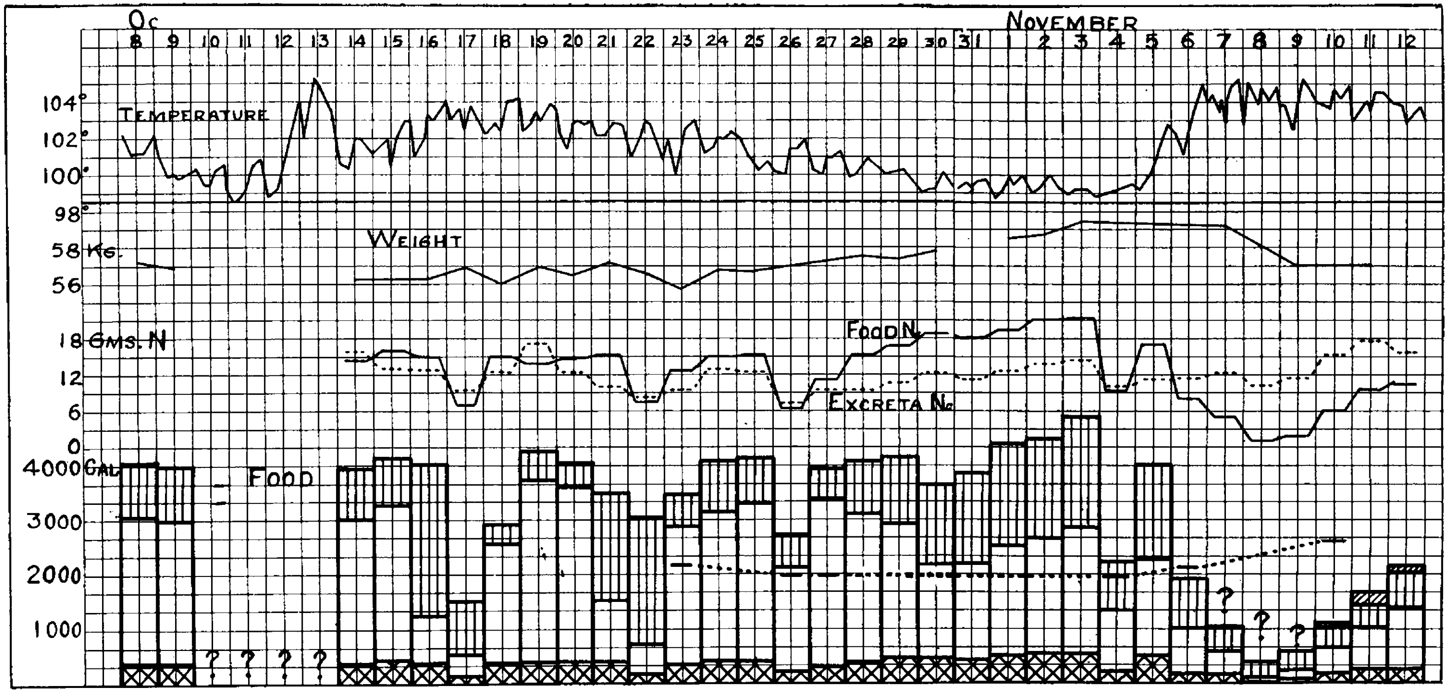

Chart 7.—Edward B. Temperature, body weight, food and excreta nitrogen. Food calories and dot-dash line representing estimated heat production. On November 7th, 8th and 9th, patient vomited, making measurement of food intake somewhat inaccurate. November 10th, 11th and 12th he received some alcohol calories.

important piece of evidence which has yet been presented in the discussion of the so-called toxic destruction of protein. Clinicians have long been aware of the large excretion of nitrogen in fever and have attributed it to an abnormal destruction of protein caused by the toxins of the disease. It is not necessary in this connection to review the older clinical work, since that is admirably presented in the standard discus-

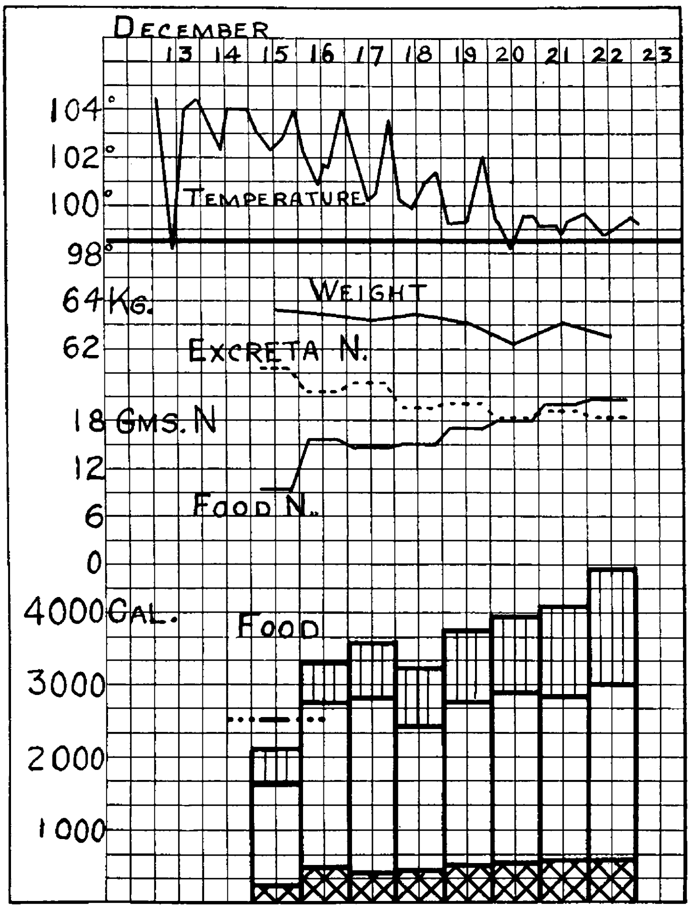

Chart 8.—John K. Temperature, body weight, food and excreta nitrogen. Food calories and dot-dash line showing estimated heat production.

sions of metabolism in fever. The results of the large number of investigations made on lower animals, while important, cannot with certainty be transferred to man.

The question of the toxic destruction of protein took on a new aspect when in 1909 Shaffer and Coleman[6] showed that it was possible to obtain nitrogen balance in typhoid patients, even during the second and third weeks of the disease. This they accomplished only by making the total caloric value of the food very high, from 60 to 90 calories per kilogram, and the food nitrogen from 9 to 15 grams. In their discussion of the results they expressed the opinion that "....it is perhaps improbable that the total heat production reached the values represented by the larger amounts of food." This work proved that there was no toxic destruction in the sense of a nitrogen loss which could not be counterbalanced by the nitrogen intake.

The question of the average heat production of typhoid patients was fully discussed in last year's paper[1] and attention was drawn to the fact that typhoid patients did not come into nitrogen equilibrium until their theoretical caloric requirement was exceeded by from 50 to 110 per cent. Grafe[10] in 1911 had shown that his typhoid patients when studied in a respiration chamber, ten to sixteen hours after their last meal, derived about 10 to 20 per cent. of their calories from protein, a percentage usually found in normal men. From this Grafe concluded that he had shown that the protein metabolism in fever was not abnormal. The percentage of calories derived from protein on the first eighteen hours after food ingestion depends largely on the previous level of the protein metabolism. Normal individuals who have been taking 15 to 19 grams of nitrogen a day will naturally derive about 15 to 20 per cent. of their calories from protein as is shown in Paper 4 of this series. Normal individuals who have been maintaining themselves in nitrogen balance on 4 to 5 grams a day will derive only 5 per cent. of their calories from protein. The comparison should have been made between normal men and typhoid patients while both were on their nitrogen minima. This will be shown later in a discussion of Kocher's work.

Rolland[11] working under Grafe's direction brought several fever patients into nitrogen balance by means of a caloric intake which she believed to be equal to the heat production as estimated from the averages of other patients. Respiration experiments were not made on the patients themselves. Our reasons for believing that the food intake was above the requirement have been set forth in another place[1] (p. 38).

Recent work from Friedrich Müller's clinic has thrown important light on the subject. Graham and Poulton[12] established themselves

10. Grafe E.: Untersuchungen über den Stoff- und Kraftwechsel im Fieber, Deutsch. Arch. f. klin. Med., 1911, ci, 209.

11. Rolland, Anne: Zur Frage des toxogenen Eiweisszerfalls im Fieber des Menschens, Deutsch. Arch. f. klin. Med., 1912, cvii, 440.

12. Graham and Poulton: Influence of Temperature on Protein Metabolism, Quart. Jour. Med., 1912, vi, 82.

on a minimal nitrogen elimination of 4 to 5 grams a day and found no increase in the elimination when they raised their temperatures to about 40 C. by means of a steam bath. Kocher[13] in two normal subjects established a nitrogen minimum at a similar level and found no increase when he raised the heat production by means of a 60 kilometer walk. All of these experiments were made on a caloric intake calculated to cover the requirement. They indicate that rise in temperature alone or increase in heat production alone will not cause an increased protein metabolism, at least when applied for a portion of one day. Kocher then attempted by means of a diet amply sufficient to cover the calculated requirement to bring down the nitrogen elimination of fever patients to the low level obtained in normal men. This he found to be impossible until the active stage of the disease was passed. Grafe[14] in a recent paper has criticized these experiments.

To all of the patients in Table 4 food was given which had an energy content much greater than the amount required by the patients as measured directly when they were in the calorimeter. Although the protein content of the diet, as represented by an intake of 15 grams of nitrogen, was ample to establish nitrogen equilibrium had the diet been given to normal men, it did not accomplish this in typhoid fever. It is difficult to see in this anything except the proof that there is an abnormal destruction of protein in typhoid fever. In some cases the protein destruction continued several days after the temperature had reached a low level. It is impossible to escape the conclusion that the destruction of protein is caused by the toxins of the disease.

SUMMARY AND CONCLUSIONS

The heat production of typhoid patients has been measured by the methods of direct and indirect calorimetry in a series of sixty-one experiments. The two methods agreed closely, the total divergence being 2.2 per cent. and the average divergence in the individual experiments being 5 per cent. This and the entire absence of abnormal respiratory quotients indicate that in typhoid fever protein, fat and carbohydrate are oxidized to the same or approximately the same end products as in health, and in their oxidation give off the standard

13. Kocher, Rudolph A.: Ueber die Grosse des Eiweisszerfalls bei Fieber und bei Arbeitsleitstung, Deutsch. Arch. f. klin. Med., 1914, cxv, 82.

14. Grafe, E.: Zur Genese des Eiweisszerfalls im Fieber, Deutsch. Arch. f. klin. Med., 1914, cvi, 328.

Subject Date Weight	Period	End of Period	Carbon-dioxid, Gm.	Oxygen, Gm.	R. Q.	Water, Gm.	Urine N per Hour, Gm.	Indirect Calorimetry, Cal.	Heat Eliminated, Cal.	Direct Calorimetry (Rectal Temp.) Cal.	Rectal Temp. C.
Morris S. ...... Oct. 24, '13 51.50 kg.	Prelim.	11:35	.....	.....	..	.....	.....	.....	.....	.....	39.86
	1	12:35	30.06	30.02	.73	47.84	0.713	97.69	83.41	84.28	39.95
	2	1:35	27.82	26.13	.77	46.72	0.713	85.89	84.68	81.00	39.89
	3	2:35	26.20	24.04	.79	39.48	0.713	79.28	74.63	85.72	40.17
Morris S. ...... Oct. 25, '13 51.22 kg.	Prelim.	11:00	.....	.....	..	.....	.....	.....	.....	.....	39.21
	1	12:00	29.65	26.82	.80	42.10	0.671	88.95	78.03	90.06	39.49
	2	1:00	28.63	25.87	.81	39.10	0.671	85.77	80.11	88.09	39.69
	3	2:00	31.75	25.46	.91	42.82	0.671	86.62	90.07	78.55	39.49
Morris S. ...... Oct. 28, '13 51.50 kg.	Prelim.	11:10	.....	.....	..	.....	.....	.....	.....	.....	39.62
	1	12:10	34.12	28.35	.88	43.31	0.732	95.71	92.00	75.53	39.27
	2	1:10	32.64	24.82	.96	42.41	0.732	85.31	94.67	76.33	38.87
	3	2:10	30.25	22.89	.96	39.40	0.732	78.60	86.73	84.65	38.81
	4	3:10	29.93	24.33	.90	34.39	0.732	82.34	78.47	93.97	39.20
	5	4:10	28.38	22.05	.94	31.75	0.732	74.59	74.35	90.84	39.65
Morris S. ...... Oct. 29, '13 49.86 kg.	Prelim.	11:10	.....	.....	..	.....	.....	.....	.....	.....	39.63
	1	12:10	26.75	23.77	.82	33.11	0.658	79.00	81.19	76.49	39.50
	2	1:10	27.49	25.95	.77	34.03	0.658	85.28	84.48	85.73	39.54
Morris S. ...... Oct. 31, '13 50.28 kg.	Prelim.	11:00	.....	.....	..	.....	.....	.....	.....	.....	39.06
	1	12:00	28.95	25.45	.83	32.13	1.058	84.11	74.09	58.27	38.94
	2	1:00	29.69	24.17	.89	36.41	1.058	81.15	79.19	79.96	39.08
	3	2:00	29.57	26.58	.80	36.76	1.058	87.50	77.70	87.13	39.43
Morris S. ...... Nov. 3, '13 48.53 kg.	Prelim.	10:30	.....	.....	..	.....	.....	.....	.....	.....	38.63
	1	11:30	24.91	20.42	.89	28.58	0.499	69.20	56.44	72.99	39.05
	2	12:30	28.70	26.23	.80	33.10	0.499	83.77	74.39	77.80	39.15
	3	1:30	27.53	27.90	.72	42.11	0.499	90.92	86.25	71.74	38.81
Morris S. ...... Nov. 5, '13 48.45 kg.	Prelim.	11:20	.....	.....	..	.....	.....	.....	.....	.....	38.08
	1	12:20	25.42	23.10	.80	29.99	0.491	76.70	77.98	81.34	38.19
	2	1:20	26.42	23.05	.83	38.62	0.491	77.19	74.75	67.00	38.01
	3	2:20	25.60	23.65	.79	39.13	0.491	78.29	72.89	75.34	38.10
Morris S. ...... Nov. 17, '13 47.99 kg.	Prelim.	11:10	.....	.....	..	.....	.....	.....	.....	.....	38.48
	1	12:10	21.90	19.01	.84	24.39	0.336	63.87	57.98	62.77	38.61
	2	1:10	23.58	20.82	.82	24.44	0.336	69.76	60.70	69.71	38.82
	3	2:10	23.79	22.28	.78	26.06	0.336	73.79	66.08	72.85	39.00
Morris S. ...... Nov. 18, '13 48.77 kg.	Prelim.	11:00	.....	.....	..	.....	.....	.....	.....	.....	39.72
	1	12:00	24.40	22.01	.81	26.55	0.567	73.01	67.36	64.94	39.67
	2	1:00	26.37	21.38	.90	28.15	0.567	72.56	71.65	82.60	39.98
	3	2:00	25.91	23.57	.80	28.88	0.567	78.11	72.05	77.47	40.15
Morris S. ...... Nov. 24, '13 46.69 kg.	Prelim.	11:13	.....	.....	..	.....	.....	.....	.....	.....	39.54
	1	12:13	29.17	25.27	.78	29.24	0.514	83.56	67.50	68.12	39.59
	2	1:13	26.91	24.54	.75	32.68	0.514	85.26	75.16	64.72	39.33
	3	2:13	26.41	25.48	.75	35.00	0.514	83.64	80.48	73.52	39.16

—Calorimetry in Typhoid Fever

Surface Temp., C.	Average Pulse	Work Adder., Cm.	Non-Protein, R. Q.	Per Cent. Calories from Protein	Per Cent. Calories from Fat	Per Cent. Calories from Carbohyd.	Calories Per Hour Per Kg.	Calories Per Hour Per Sq. M.	Remarks
.....	96(?)	36.0	.71	24	75	1	1.90	57.33	Basal.
.....	96	21.0	.77	28	58	14	1.67	50.40	
.....	105	17.0	.79	31	49	20	1.54	46.53	
.....	101	30.0+	.80	20	54	26	1.74	52.36	9:30-10:00 a. m., protein meal. 9.0 gm. N.
.....	96	21.5	.81	21	52	27	1.68	50.48	
.....	105	18.0++	.94	21	17	62	1.69	50.98	
.....	119	35.0	.90	20	29	51	1.88	66.70	At 10:22, 115 gm. com. glucose = 100 gm. dextrose. Asleep from 3-3:40.
.....	113	25.0+5?	1.01	23	..	77	1.68	50.54	
.....	108	30.5	1.02	25	..	75	1.55	46.56	
.....	108	18.0	.93	24	19	57	1.62	48.78	
.....	107	9.0	.99	26	3	71	1.47	44.19	
.....	105	24.0	.82	22	47	31	1.58	47.17	Basal.
.....	106	17.5	.76	20	65	15	1.70	50.91	
.....	101	10.0 (?)	.84	33	36	31	1.68	50.16	8:40-9:20, protein meal; 10.3 gm. N.
.....	102	11.2+	.95	35	12	53	1.62	48.39	
.....	98	9.5	.81	32	44	24	1.74	52.18	
.....	106	11.7	.91	19	25	56	1.42	42.09	Basal. 1st. hr. quiet, 2d. hr. restless, 3d. hr. restless; wrote 3 or 4 notes.
.....	111	32.0	.79	16	59	25	1.71	50.96	
.....	106	8.0+	.70	15	85	..	1.86	55.30	
.....	98	5.5	.80	17	56	27	1.58	46.89	Basal.
.....	109	8.0	.84	17	45	38	1.59	47.18	
.....	112	8.0	.78	17	61	22	1.62	47.86	
37.29									
37.52	100	11.0	.84	14	45	41	1.33	39.28	Basal.
37.83	113	6.8	.83	13	51	36	1.45	42.90	
37.94	112	3.0	.77	12	68	20	1.54	45.38	
38.89									
38.98	114	0.3	.81	21	52	27	1.50	44.44	Basal.
39.27	117	14.7	.92	21	20	59	1.49	44.16	
39.16	124	13.7	.80	19	55	26	1.60	47.54	
.....	...	12.0	.78	16	64	20	1.77	52.32	Basal.
.....	122	0.0	.74	16	73	11	1.81	53.39	
.....	126	0.5	.74	16	73	11	1.78	52.37	

TABLE 5.—CLINICAL CALORIMETRY—

Subject Date Weight	Period	End of Period	Carbon-dioxid, Gm.	Oxygen, Gm.	R. Q.	Water, Gm.	Urine N per Hour, Gm.	Indirect Calo-rimetry, Cal.	Heat Elimi-nated, Cal.	Direct Calo-rimetry (Rectal Temp.) Cal.	Rectal Temp. C.
Morris S. ...... Nov. 25, '13 47.24 kg.	Prelim.	11:20	.....	.....	..	.....	.....	.....	.....	.....	39.40
	1	12:20	28.17	24.45	.84	29.86	0.618	81.79	71.86	66.66	39.30
	2	1:20	30.38	26.92	.82	47.61	0.618	89.78	91.51	78.22	38.97
	3	2:20	29.26	27.94	.78	48.78	0.618	89.93	88.95	95.35	39.13
Morris S. ...... Nov. 26, '13 46.11 kg.	Prelim.	10:50	.....	.....	..	.....	.....	.....	.....	.....	39.61
	1	11:50	26.29	24.80	.77	27.88	0.329	82.10	69.08	52.60	39.19
	2	12:50	25.68	24.64	.76	34.79	0.329	81.28	79.19	71.14	38.99
	3	1:50	25.70	24.85	.75	42.13	0.329	81.84	88.38	79.59	38.77
Morris S. ...... Dec. 12, '13 48.61 kg.	Prelim.	10:56	.....	.....	..	.....	.....	.....	.....	.....	37.01
	1	11:56	23.45	20.22	.84	18.48	0.272	68.20	61.73	53.71	36.82
	2	12:56	23.88	20.96	.83	21.26	0.272	70.44	64.58	69.48	36.95
	3	1:56	24.99	21.42	.85	24.01	0.272	72.36	66.64	69.52	37.03
Morris S. ...... Dec. 13, '13 48.07 kg.	Prelim.	10:36	.....	.....	..	.....	.....	.....	.....	.....	37.07
	1	11:36	18.99	16.89	.82	18.84	0.323	56.39	58.07	50.93	36.90
	2	12:36	20.10	17.29	.85	19.31	0.323	58.16	58.63	63.06	37.02
	3	1:36	20.76	18.90	.80	20.26	0.323	62.88	61.95	63.59	37.07
Morris S. ...... Dec. 15, '13 48.17 kg.	Prelim.	10:52	.....	.....	..	.....	.....	.....	.....	.....	37.30
	1	11:52	24.51	18.29	.98	18.41	0.384	63.45	58.74	47.60	37.03
	2	12:52	26.76	18.98	1.03	20.90	0.384	66.42	63.52	64.97	37.10
	3	1:52	26.83	18.82	1.04	22.07	0.384	65.97	64.19	67.97	37.23
Morris S. ...... Dec. 16, '13 47.86 kg.	Prelim.	11:06	.....	.....	..	.....	.....	.....	.....	.....	37.32
	1	12:06	22.51	17.81	.92	20.83	0.299	61.10	63.36	61.62	37.30
	2	1:06	21.91	18.33	.87	21.42	0.299	62.12	62.76	63.36	37.33
	3	2:06	22.37	19.33	.84	21.79	0.299	65.08	63.87	60.35	37.25
Morris S. ...... Dec. 19, '13 48.74 kg.	Prelim.	11:10	.....	.....	..	.....	.....	.....	.....	.....	39.19
	1	12:10	27.38	21.99	.91	22.55	0.493	74.94	70.40	67.95	39.14
	2	1:10	30.04	22.70	.96	25.64	0.493	78.51	75.00	84.00	39.41
	3	2:10	29.47	23.51	.91	27.26	0.493	80.32	74.21	87.13	39.75
Morris S. ...... Dec. 20, '13 48.52 kg.	Prelim.	10:40	.....	.....	..	.....	.....	.....	.....	.....	39.29
	1	11:40	23.69	22.51	.77	23.81	0.547	73.93	67.11	76.36	39.53
	2	12:40	25.60	23.42	.80	25.60	0.547	77.57	70.95	78.45	39.76
	3	1:40	25.51	23.84	.78	27.47	0.547	78.68	72.88	72.56	39.77
Morris S. ...... Dec. 22, '13 48.87 kg.	Prelim.	11:16	.....	.....	..	.....	.....	.....	.....	.....	38.65
	1	12:36	37.28	28.77	.94	37.28	0.705	98.85	97.57	112.39	39.05
	2	1:36	28.84	22.32	.94	28.28	0.529	76.65	73.08	88.65	39.47
	3	2:36	28.86	22.21	.95	29.24	0.529	76.39	74.60	78.88	39.59
Morris S. ...... Dec. 23, '13 48.60 kg.	Prelim.	11:06	.....	.....	..	.....	.....	.....	.....	.....	38.04
	1	12:06	23.51	21.45	.80	25.82	0.428	71.21	68.75	73.19	38.16
	2	1:06	23.94	21.92	.80	25.39	0.428	72.73	70.84	80.86	38.46
	3	2:06	24.35	22.79	.78	25.38	0.428	75.32	69.85	76.84	38.66
Morris S. ...... Jan. 2, '14 49.26 kg.	Prelim.	11:16	.....	.....	..	.....	.....	.....	.....	.....	36.97
	1	12:16	19.10	16.62	.84	19.75	0.386	55.63	58.53	52.15	36.85
	2	1:16	19.27	17.07	.82	20.20	0.386	56.94	57.89	64.93	37.05
	3	2:16	19.80	18.38	.78	22.05	0.386	60.77	61.54	60.88	37.07

Surface Temp., C.	Average Pulse	Work Adder., Cm.	Non-Protein, R. Q.	Per Cent. Calories from			Calories Per Hour		Remarks
				Protein	Fat	Carbohyd.	Per Kg	Per Sq. M.	
38.37									
38.66	112	18.5	.85	20	42	38	1.72	50.83	9.35:10:15, protein meal; 8.7 gm. N. Began to sweat at end of second hour.
38.12	122	12.2	.83	18	49	33	1.89	55.80	
37.76	119	9.5	.78	18	62	20	1.90	55.89	
38.87									
38.59	112	5.5	.77	11	70	19	1.79	51.83	Basal. Patient restless in second period.
38.18	119	11.0+	.75	11	75	14	1.77	51.31	
37.53	123	12.0	.75	11	77	12	1.78	51.67	
35.60									
35.52	91	3.8	.85	11	46	43	1.40	41.59	9:03-9:30, protein meal; 10.6 gm. N.
35.69	94	18.6	.83	10	51	39	1.45	42.95	
35.73	98	14.5	.85	10	45	45	1.49	44.12	
35.82									
35.64	74	9.0	.82	15	52	33	1.17	34.64	Basal. Asleep in first period.
35.82	88	9.2	.85	15	43	42	1.21	35.73	
35.98	87	7.5	.80	14	59	27	1.31	38.62	
35.98									
35.54	83	6.0	1.01	16	..	84	1.32	38.95	At 10:13, 115 gm. commercial glucose.
35.72	102	5.1	1.07	15	..	85	1.38	40.77	
35.75	100	1.2	1.09	15	..	85	1.37	40.50	
35.99									
35.93	84	5.7	.94	13	18	69	1.28	37.65	Basal.
35.95	87	2.5	.88	13	35	52	1.30	38.27	
36.00	93	7.0	.85	12	46	42	1.36	40.10	
37.52									
37.29	105	0.3	.93	17	20	63	1.54	45.64	At 10:26, 115 gm. commercial glucose.
37.64	121	7.3	1.00	17	1	82	1.61	47.81	
37.71	121	2.0	.94	16	19	65	1.65	48.92	
37.49									
37.59	108	1.6	.76	20	67	13	1.55	45.13	Basal.
37.87	114	8.1	.79	19	57	24	1.63	47.36	
37.91	117	2.2	.77	18	64	18	1.65	48.00	
36.85									
37.44	109	9.2	.98	19	6	75	1.52	45.07	At 10:24, 115 gm. commercial glucose. First period 1 hr. 20 min. because patient moved at end of hour.
37.67	120	6.5	.97	18	8	74	1.57	46.61	
37.71	120	1.2	.98	18	6	76	1.57	46.44	
36.64									
36.62	99	1.2	.80	16	58	26	1.46	43.42	Basal.
36.80	100	9.2	.79	16	59	25	1.50	44.35	
37.07	105	4.0	.77	15	66	19	1.55	45.93	
35.49									
35.57	69	8.8	.84	18	44	38	1.13	33.63	Basal.
35.57	76	1.6	.83	18	49	33	1.15	34.43	
35.71	79	4.6	.78	17	57	26	1.23	36.74	

Subject Date Weight	Period	End of Period	Carbon-dioxid, Gm.	Oxygen, Gm.	R. Q.	Water, Gm.	Urine N per Hour, Gm.	Indirect Calorimetry, Cal.	Heat Eliminated, Cal.	Direct Calorimetry (Rectal Temp.) Cal.	Rectal Temp. C.
Morris S.	Prelim.	11:45	.....	.....	..	.....	.....	.....	.....	.....	37.06
Jan. 27, '14 57.50 kg.	1	12:45	19.39	17.28	.82	21.44	0.365	57.63	69.67	56.44	36.79
	2	1:45	22.28	19.73	.82	21.96	0.365	65.98	71.20	73.22	36.90
	3	2:45	22.21	19.73	.82	22.74	0.365	65.94	70.02	72.00	36.97
Morris S.	Prelim.	11:27	.....	.....	..	.....	.....	.....	.....	.....	36.89
Dec. 17, '14 61.21 kg.	1	12:27	21.46	19.30	.81	25.58	0.381	64.27	70.65	64.61	36.70
	2	1:27	23.25	21.17	.80	27.85	0.381	70.42	72.99	70.69	36.79
	3	2:27	23.02	20.52	.82	27.74	0.381	68.53	72.30	68.84	36.81
Morris S.	Prelim.	11:00	.....	.....	..	.....	.....	.....	.....	.....	37.02
Dec. 18, '14 62.81 kg.	1	12:00	27.56	22.40	.90	31.97	0.409	76.31	77.07	71.53	36.92
	2	1:00	29.29	24.39	.87	34.09	1.101	81.43	84.04	82.67	36.94
	3	2:00	23.14	19.14	.88	29.33	1.101	63.50	76.85	73.79	36.89
	4	3:00	25.29	21.01	.88	31.79	1.101	69.82	78.61	74.47	36.85
Charles F.	Prelim.	11:10	.....	.....	..	.....	.....	.....	.....	.....	38.94
Nov. 10, '13 57.73 kg.	1	12:10	26.83	24.23	.81	26.28	0.514	80.56	66.11	79.70	39.21
	2	1:10	27.37	25.08	.79	28.78	0.514	83.17	71.87	73.83	39.26
	3	2:10	27.91	25.99	.78	43.30	0.514	85.95	88.09	77.90	39.05
Charles F.	Prelim.	11:20	.....	.....	..	.....	.....	.....	.....	.....	38.82
Nov. 11, '13 58.22 kg.	1	12:20	28.97	24.58	.86	25.84	0.930	82.03	67.32	78.05	39.05
	2	1:20	30.21	26.74	.82	31.12	0.930	88.58	77.70	86.96	39.25
	3	2:20	31.40	27.66	.83	31.13	0.930	91.78	82.04	99.99	39.63
Charles F. ...	Prelim.	11:10	.....	.....	..	.....	.....	.....	.....	.....	39.62
Nov. 14, '13 57.94 kg.	1	12.10	32.69	26.60	.89	32.29	0.813	89.98	83.73	83.31	39.62
	2	1:10	31.92	25.64	.91	32.26	0.813	87.23	81.28	68.87	39.37
	3	2:10	32.24	26.33	.89	32.95	0.813	88.98	89.47	91.35	39.49
Charles F.	Prelim.	11:16	.....	.....	..	.....	.....	.....	.....	.....	39.77
Nov. 15, '13 57.03 kg.	1	12:16	28.26	26.44	.78	28.84	0.657	87.09	75.09	82.25	39.93
	2	1:16	28.23	26.08	.79	32.35	0.657	86.12	86.12	74.34	39.88
Charles F.	Prelim.	11:26	.....	.....	..	.....	.....	.....	.....	.....	36.71
Nov. 29, '13 50.36 kg.	1	12:26	21.39	18.31	.85	29.25	0.483	61.69	61.79	59.74	36.67
	2	1:26	22.05	20.15	.80	28.24	0.483	67.01	63.78	75.00	37.00
	3	2:26	21.99	19.44	.82	27.10	0.483	65.08	63.75	72.92	37.25
Charles F.	Prelim.	11:10	.....	.....	..	.....	.....	.....	.....	.....	36.90
Dec. 8, '13 50.99 kg.	1	12:10	25.97	19.63	.96	21.83	0.817	66.98	62.72	52.64	36.67
	2	1:10	26.73	21.61	.90	25.30	0.817	72.92	70.29	75.47	36.85
	3	2:10	25.97	21.12	.90	29.04	0.817	71.13	74.23	76.85	36.95
Charles F.	Prelim.	11:06	.....	.....	..	.....	.....	.....	.....	.....	36.78
Dec. 9, '13 50.38 kg.	1	12:06	22.60	18.05	.91	19.36	0.380	61.66	58.80	55.10	36.70
	2	1:06	22.10	17.29	.93	22.22	0.380	59.30	64.40	69.90	36.87
	3	2:06	21.98	17.63	.91	22.36	0.380	60.15	61.83	61.55	36.88
Charles F.	Prelim.	11:10	.....	.....	..	.....	.....	.....	.....	.....	36.89
Dec. 10, '13 51.09 kg.	1	12:10	26.98	20.24	.97	22.40	0.362	70.28	62.46	58.29	36.80
	2	1:10	27.70	19.45	1.04	24.37	0.362	68.24	68.32	64.48	36.76
	3	2:10	25.68	18.90	.99	28.76	0.362	65.28	72.63	60.44	36.50

Surface Temp., C.	Average Pulse	Work Adder., Cm.	Non-Protein, R. Q.	Per Cent. Calories from			Calories Per Hour		Remarks
				Protein	Fat	Carbohyd.	Per Kg.	Per Sq. M.	
35.61									
35.11	60	0.5	.82	17	51	32	1.00	31.29	Basal.
35.15	71	5.6	.82	15	51	34	1.15	35.82	
35.37	68	5.2	.82	15	52	33	1.15	35.80	
.....	62	4.0	.81	16	55	29	1.05	33.61	Basal.
.....	65	6.0	.80	14	58	28	1.15	36.83	
.....	62	5.0	.82	15	52	33	1.12	35.03	
.....	..	5.0	.91	14	21	65	1.22	39.23	At 8:40-9:40 a. m., protein meal; 9.6 gm. N.
.....	74	6.0	.92	36	17	47	1.30	41.87	
.....	70	6.0	.95	46	9	45	1.01	32.65	
.....	62	6.0	.93	42	14	44	1.11	35.90	
.....	76	3.5	.81	17	55	28	1.40	43.81	Basal.
.....	76	2.0	.79	16	60	24	1.44	45.23	
.....	82	9.0	.78	16	64	20	1.49	46.74	
37.69									
38.24	77	3.5	.88	30	28	42	1.41	44.34	9:10-10:10, protein meal; Nitrogen 6.6 gm.
38.25	86	13.0	.83	28	42	30	1.52	47.88	
38.34	84	4.0	.83	27	41	32	1.57	49.61	
38.79									
38.90	97	15.0	.93	24	19	57	1.56	48.80	At 10:21 a. m., 115 gm. commercial glucose.
38.68	98	8.3	.94	25	15	60	1.52	47.31	
38.79	96	25.0	.92	24	21	55	1.55	48.25	
38.92									
39.10	90	17.0	.77	20	63	17	1.53	47.75	Basal.
39.04	88	15.5	.78	20	59	21	1.51	47.22	
.....	80	13.2	.86	21	37	42	1.23	36.81	Basal.
.....	86(?)	16.5	.79	20	56	24	1.33	39.98	
.....	84	18.8	.83	20	47	33	1.30	38.83	
36.24									
36.54	74	36.6	1.05	32	..	68	1.31	39.54	9:03-9:45, protein meal: 10.5 gm. N. Work adder too high on account of rapid changes in barometer.
36.16	72	20.3	.94	30	13	57	1.43	43.05	
36.37	84(92)	15.0	.94	30	15	55	1.40	41.99	
.....	75	22.3	.93	16	19	65	1.23	36.72	Basal.
.....	76	23.0	.96	17	12	71	1.18	35.32	
.....	84	9.7	.93	17	20	63	1.20	35.83	
.....	73	10.0	1.00	14	..	86	1.38	41.46	At 10:22, 115 gm. commercial glucose.
.....	87	23.5+2?	1.08	14	..	86	1.34	40.26	
.....	81	38.0+2?	1.02	15	..	85	1.29	38.81	

TABLE 5.—CLINICAL CALORIMETRY—

Subject Date Weight	Period	End of Period	Carbon-dioxid, Gm.	Oxygen, Gm.	R. Q.	Water, Gm.	Urine N per Hour, Gm.	Indirect Calorimetry, Cal.	Heat Eliminated, Cal.	Direct Calorimetry (Rectal Temp.) Cal.	Rectal Temp. C.
Charles F. .... Dec. 26, '13 55.87 kg.	Prelim.	11:12	.....	.....	..	.....	.....	.....	.....	.....	36.84
	1	12:12	23.75	19.16	.90	26.72	0.275	65.56	75.47	75.27	36.90
	2	1:12	21.98	18.86	.85	25.23	0.275	63.65	69.83	67.08	36.86
	3	2:12	22.11	20.10	..80	25.14	0.275	67.03	70.63	69.23	36.85
Charles F. .... Dec. 31, '13 55.98 kg.	Prelim.	1:40	.....	.....	..	.....	.....	.....	.....	.....	37.08
	1	2:40	21.85	19.82	.80	22.56	0.403	65.85	66.09	59.70	36.95
	2	3:40	22.81	21.14	.78	26.98	0.403	69.98	69.09	68.75	36.95
Howard F. .... Nov. 7, '13 35.47 kg.	Prelim.	11:16	.....	.....	..	.....	.....	.....	.....	.....	39.74
	1	12:16	22.09	20.53	.78	22.79	.....	68.25	57.28	56.71	39.73
	2	1:16	21.02	19.75	.77	24.24	.....	65.53	64.17	63.90	39.73
	3	2 :16	20.86	.....	..	24.06	.....	65.03 ?	64.99	60.30	39.58
Howard F. .... Nov. 12, '13 34.98 kg.	Prelim.	11:24	.....	.....	..	.....	.....	.....	.....	.....	39.64
	1	12:24	22.06	19.37	.83	20.58	0.612	64.40	58.89	61.38	39.74
	2	1:24	23.23	20.40	.83	23.38	0.612	67.88	63.72	65.61	39.89
	3	2:24	22.55	21.27	.77	23.60	0.612	69.78	63.49	70.09	40.15
Howard F. .... Nov. 13, '13 34.19 kg.	Prelim.	11:00	.....	.....	..	.....	.....	.....	.....	.....	39.76
	1	12:00	19.45	17.76	.80	22.30	0.436	58.81	57.80	59.64	39.84
	2	1:00	19.64	18.48	.77	22.62	0.436	60.86	58.19	57.19	39.82
	3	2:00	20.20	19.24	.76	23.66	0.436	63.22	63.74	62.17	39.78
Howard F. .... Nov. 20, '13 32.54 kg.	Prelim.	11:30	.....	.....	..	.....	.....	.....	.....	.....	39.31
	1	12:30	18.43	17.26	.78	27.43	0.354	56.98	55.72	55.87	39.33
	2	1:30	18.27	17.42	.76	27.31	0.354	57.30	63.70	58.16	39.14
	3	2:30	17.96	17.42	.75	25.62	0.354	57.10	59.75	53.97	38.94
Howard F. .... Dec. 1, '13 32.93 kg.	Prelim.	11:06	.....	.....	..	.....	.....	.....	.....	.....	37.03
	1	12:06	19.35	14.58	.97	18.80	0.292	50.50	45.34	42.26	36.93
	2	1:06	39.56	29.26	.98	37.03	0.292	101.68	46.88	97.14	36.96
	3	2:06							50.17		36.97
Howard F. .... Dec. 2, '13 33.06 kg.	Prelim.	11:12	.....	.....	..	.....	.....	.....	.....	.....	36.84
	1	12:12	15.46	12.42	.91	17.57	0.234	42.40	44.03	42.30	36.79
	2	1:12	18.09	13.48	.98	18.64	0.234	46.86	50.53	52.20	36.93
Howard F. .... Dec. 5, '13 34.74 kg.	Prelim.	11:06	.....	.....	..	.....	.....	.....	.....	.....	37.07
	1	12:06	22.13	17.28	.93	21.01	0.614	58.85	55.03	51.80	36.97
	2	1:06	24.24	17.61	1.00	21.99	0.614	60.75	61.84	64.82	37.17
	3	2:06	24.72	19.43	.93	23.61	0.614	66.21	64.12	65.52	37.25
Howard F. .... Dec. 6, '13 33.78 kg.	Prelim.	10:56	.....	.....	..	.....	.....	.....	.....	.....	37.02
	1	11:56	18.20	13.44	.98	17.44	0.267	46.71	47.88	46.67	36.99
	2	12:56	19.17	14.84	.94	18.30	0.267	51.14	51.37	51.43	37.06
Howard F. .... Dec. 18, '13 37.17 kg.	Prelim.	11:06	.....	.....	..	.....	.....	.....	.....	.....	37.11
	1	12:06	19.11	16.10	.86	18.73	0.314	54.38	53.61	52.94	37.10
	2	1:06	21.42	18.19	.86	20.94	0.314	61.42	58.80	63.36	37.29
	3	2:06	20.93	18.62	.81	23.84	0.314	62.26	65.14	63.04	37.25

—IN TYPHOID FEVER—(*Continued*)

Surface Temp., C.	Average Pulse	Work Adder., Cm.	Non-Protein, R. Q.	Per Cent. Calories from			Calories Per Hour		Remarks
				Protein	Fat	Carbohyd.	Per Kg.	Per Sq. M.	
36.02									
36.09	76	23.2	.92	11	26	63	1.18	36.44	Basal
36.38	..	18.3	.85	11	44	45	1.14	35.38	
35.74	..	10.2	.80	11	61	28	1.20	37.26	
36.90									
35.98	78	4.0	.80	16	57	27	1.18	36.38	Basal.
36.68	81	....	.78	15	64	21	1.25	38.66	
.....	100	10.0	....	..	..	..	1.91	51.35	Basal. Urine not obtained; O_2 lost in third period.
.....	103	6.0	....	..	..	..	1.83	49.31	
.....	106	2.0	....	..	..	..	1.83(?)	48.93(?)	
39.01									
39.13	105	2.5	.84	25	41	34	1.84	48.90	9:10-9:40, protein meal; 6.5 gm. N. Asleep most of first period.
39.30	104	9.5	.84	24	42	34	1.94	51.55	
39.76	105	5.5	.76	23	63	14	2.00	52.99	
.....	108	1.0	.79	20	56	24	1.72	45.34	Basal.
.....	108	2.5	.77	19	65	16	1.78	46.92	
.....	104	7.7	.75	18	79	13	1.85	48.74	
39.14									
38.89	103	9.6	.77	16	65	19	1.75	45.41	Basal.
38.68	102	9.6	.75	16	70	14	1.76	45.66	
38.88	92	9.5	.74	16	75	9	1.75	45.50	
37.19									
37.16	98	2.6	1.00	15	1	84	1.53	39.92	At 10:19, 115 gm. commercial glucose; second and third periods averaged.
36.63	97	5.1 }	1.02	15	..	85	1.55	40.19	
37.21	97	6.0 }							
36.92									
36.83	75	2.5	.92	15	22	63	1.28	33.39	Basal. Asleep most of first hour.
36.60	76	15.6	1.01	13	..	87	1.42	36.90	
.....	91	7.0	.99	28	3	69	1.70	44.90	9.00-10:00, protein meal; 10.2 gm. N. Asleep first period.
.....	90	20.5	1.08	27	..	73	1.75	46.34	
.....	93	6.5(?)	.97	25	8	67	1.91	50.51	
.....	73	6.6	1.02	15	..	85	1.38	36.31	Basal. Asleep one-half first period.
.....	76	14.2	.96	14	11	75	1.51	39.75	
36.61									
36.82	104	5.5	.87	15	37	48	1.46	39.66	Basal. Asleep first period.
37.00	112	13.0	.87	14	40	46	1.65	44.79	
36.76	105	17.3	.82	13	53	34	1.68	45.40	

TABLE 5.—Clinical Calorimetry—

Subject Date Weight	Period	End of Period	Carbon-dioxid, Gm.	Oxygen, Gm.	R. Q.	Water, Gm.	Urine N per Hour, Gm.	Indirect Calorimetry, Cal.	Heat Eliminated, Cal.	Direct Calorimetry (Rectal Temp.) Cal.	Rectal Temp. C.
Howard F.	Prelim.	1:30	.....	.....	..	.....	.....	.....	.....	.....	37.29
Dec. 30, '13 39.40 kg.	1	2:30	19.66	17.18	.83	22.45	0.278	57.68	62.50	55.92	37.10
	2	3:30	20.74	18.62	.81	23.93	0.278	62.21	60.31	61.45	37.17
Karl S.	Prelim.	11:50	.....	.....	..	.....	.....	.....	.....	.....	40.14
Jan. 5, '14 54.64 kg.	1	12:50	30.78	29.50	.76	39.97	0.720	96.73	101.70	91.12	39.92
	2	1:50	29.73	28.53	.76	42.23	0.720	93.48	104.45	93.93	39.70
Karl S.	Prelim.	12:30	.....	.....	..	.....	.....	.....	.....	.....	39.53
Jan. 6, '14 54.52 kg.	1	1:30	34.01	29.51	.84	26.77	0.879	98.46	87.72	112.04	40.08
	2	2:30	35.13	31.49	.81	34.31	0.879	104.43	104.39	99.22	40.05
	3	3:30	35.32	31.56	.81	38.70	0.879	104.75	107.68	105.06	40.02
Karl S.	Prelim.	10:50	.....	.....	..	.....	.....	.....	.....	.....	38.29
Jan. 16, '14 52.21 kg.	1	11:50	26.55	25.94	.74	26.51	0.786	84.44	.....	.....	38.32
	2	1:02	32.49	28.88	.82	38.71	0.943	95.01	.....	.....	38.22
	3	1:50	21.52	19.72	.80	32.34	0.655	64.72	.....	.....	38.14
Karl S.	Prelim.	10:50	.....	.....	..	.....	.....	.....	.....	.....	36.36
Jan. 19, '14 51.19 kg.	1	11:50	20.70	16.34	.92	12.72	0.522	55.62	.....	.....	36.54
	2	12:50	22.08	18.41	.87	28.28	0.522	62.03	.....	.....	36.55
	3	1:50	22.53	19.41	.84	32.55	0.522	64.98	.....	.....	36.57
Karl S.	Prelim.	12:30	.....	.....	..	.....	.....	.....	.....	.....	36.72
Jan. 21, '14 51.29 kg.	1	1:30	24.09	19.71	.89	32.46	0.858	66.11	.....	.....	36.55
	2	2:30	23.96	19.57	.89	25.79	0.858	65.65	.....	.....	36.39
	3	3:30	26.95	21.45	.91	32.17	0.858	72.55	.....	.....	36.46
Karl S.	Prelim.	12:40	.....	.....	..	.....	.....	.....	.....	.....	36.75
Jan. 22, '14 50.63 kg.	1	1:40	18.66	15.37	.88	16.87	0.428	51.92	.....	.....	36.54
	2	2:40	21.01	16.98	.90	20.51	0.428	57.70	.....	.....	36.40
	3	3:40	20.54	17.06	.88	22.17	0.428	57.62	.....	.....	36.48
Karl S.	Prelim.	11:05	.....	.....	..	.....	.....	.....	.....	.....	37.15
Feb. 6, '14 53.30 kg.	1	12:05	23.16	20.28	.83	23.98	0.324	68.07	67.32	58.11	36.95
	2	1:05	21.97	18.82	.85	22.85	0.324	63.43	67.46	56.97	36.72
	3	2:05	25.49	24.36	.76	27.16	0.324	80.44	74.45	80.28	36.86
Karl S.	Prelim.	10:46	.....	.....	..	.....	.....	.....	.....	.....	37.35
Feb. 7, '14 54.45 kg.	1	11:46	27.92	22.71	.89	32.41	0.581	77.05	77.13	60.51	36.99
	2	12:46	27.33	21.87	.91	29.12	0.581	74.43	79.33	74.46	36.89
	3	1:46	26.23	21.16	.90	32.41	0.581	71.85	79.75	76.71	36.83
Thomas B.	Prelim.	10:48	.....	.....	..	.....	.....	.....	.....	.....	36.79
Oct. 15, '13 73.62 kg.	1	11:48	24.87	22.60	.80	23.50	0.505	75.00	48.97	70.72	37.13
	2	12:48	27.05	22.82	.86	24.88	0.505	76.95	56.97	72.61	37.38
	3	1:48	26.46	24.69	.78	26.46	0.505	81.57	63.67	74.67	37.58
	4	2:48	28.39	24.58	.84	28.78	0.505	82.49	67.68	79.68	37.78
Thomas B.	Prelim.	10:24	.....	.....	..	.....	.....	.....	.....	.....	36.69
Oct. 21, '13 72.56 kg.	1	11:24	22.98	20.14	.83	24.71	0.407	67.43	.....	52.61	36.71
	2	12:24	24.90	19.11	.95	29.65	0.407	65.88	65.03	63.75	36.71
	3	1:24	26.13	20.21	.94	30.15	0.407	69.58	68.06	62.32	36.64

—IN TYPHOID FEVER—(*Continued*)

Surface Temp., C.	Average Pulse	Work Adder., Cm.	Non-Protein, R. Q.	Per Cent. Calories from			Calories Per Hour		Remarks
				Protein	Fat	Carbohyd.	Per Kg.	Per Sq. M.	
36.57									
36.44	109	6.5	.84	13	48	39	1.47	40.49	Basal. Asleep greater part of both periods.
36.60	107	8.5	.81	12	57	31	1.58	43.67	
39.24									
38.97	114	8.4	.75	20	69	11	1.77	54.93	Basal.
38.67	109	6.7	.75	20	69	11	1.71	53.08	
38.60									
39.61	107	8.8	.85	24	39	37	1.80	55.62	9:45-10:12, protein meal; 10.5 gm. N.
39.39	99(?)	14.6	.81	22	50	28	1.92	59.00	
39.27	119	13.0	.82	22	49	29	1.92	59.18	
.....	92	12.2	.72	25	70	5	1.62	49.09	Basal. Water ther. broken. Second period 72 min. long on account movement.
.....	96	21.0+3?	.82	26	44	30	1.53	46.03	
.....	96	11.0	.77	26	57	17	1.55	45.15	
.....	76	10.6	.96	25	9	66	1.09	32.74	Basal.
.....	76	14.8+4	.89	22	28	50	1.21	36.51	
.....	78	16.8	.86	21	39	40	1.27	38.25	
.....	73	9.8	.94	34	14	52	1.29	38.89	9:35-11:36, protein meal; 10.0 gm. N.
.....	69	5.7	.94	35	13	52	1.28	38.62	
.....	74	17.0	.97	31	7	62	1.42	42.68	
.....	59	4.0	.91	22	25	53	1.03	30.81	Basal. Asleep first period.
.....	57	11.7	.93	20	20	60	1.14	34.24	
.....	68	9.2	.90	20	29	51	1.14	34.20	
36.20									
36.52	81	15.5	.84	13	49	38	1.28	39.03	Basal. Asleep about 30 min. in first period and 50 min. in second.
35.86	79	9.4	.86	14	42	44	1.19	36.37	
35.97	82	25.2	.76	11	74	15	1.51	46.12	
36.40									
36.58	94	12.4	.92	20	22	58	1.41	43.56	7:30-7:40, 44.3 gm. protein; 9:35-9:37, 15.6 gm. protein; total, 9.6 gm. N. Asleep most of the time.
35.97	90	7.2	.94	21	16	63	1.37	42.07	
36.24	86	11.0	.93	21	19	60	1.32	40.62	
.....	81	8.0	.80	18	56	26	1.02	34.67	Basal.
.....	85	14.0	.88	17	35	48	1.05	35.58	
.....	84	7.6	.77	16	65	19	1.11	87.71	
.....	91	21.0	.85	16	43	41	1.12	38.14	
.....	73(?)	12.0	.84	16	47	37	0.93	31.48	Basal.
.....	78	19.0	.98	16	6	78	0.91	30.76	
.....	84	....	.97	16	9	75	0.96	32.48	

Subject Date Weight	Period	End of Period	Carbon-dioxid, Gm.	Oxygen, Gm.	R. Q.	Water, Gm.	Urine N per Hour, Gm.	Indirect Calorimetry, Cal.	Heat Eliminated, Cal.	Direct Calorimetry (Rectal Temp.) Cal.	Rectal Temp. C.
Richard T. .... Oct. 18, '13 36.49 kg.	Prelim.	9:48	.....	.....	..	.....	.....	.....	.....	.....	38.13
	1	10:48	20.39	18.59	.80	30.29	0.403	61.65	43.77	57.62	38.60
	2	11:48	21.05	18.24	.84	21.24	0.403	61.12	42.57	66.86	39.50
	3	12:48	20.49	18.68	.80	25.61	0.403	61.95 ?	45.94	52.35	39.74
Richard T. .... Oct. 20, '13 35.37 kg.	Prelim.	10:16	.....	.....	..	.....	.....	.....	.....	.....	37.68
	1	11:16	18.98	15.18	.91	31.21	0.499	51.48	42.37	58.44	38.24
	2	12:16	21.25	18.39	.84	31.41	0.499	61.49	47.46	58.51	38.63
	3	1:16	19.90	17.96	.81	29.74	0.499	59.49	48.42	46.90	38.64
Anton K. ...... Oct. 16, '13 50.55 kg.	Prelim.	11:16	.....	.....	..	.....	.....	.....	.....	.....	36.99
	1	12:16	22.48	18.64	.88	30.88	0.479	62.98	61.00	61.00	36.99
	2	1:16	21.65	19.08	.83	33.40	0.479	63.64	66.45	72.34	37.14
	3	2:16	23.57	19.73	.87	30.29	0.479	66.57	64.84	68.64	37.24
Rose G. .... Nov. 22, '13 30.11 kg.	Prelim.	11:04	.....	.....	..	.....	.....	.....	.....	.....	37.04
	1	12:04	17.77	15.73	.82	28.24	.....	52.81	51.24	53.76	37.15
	2	12:34	9.28	7.28	.93	17.44	.....	24.98	28.36	24.99	37.02
Edw. B. .... Oct. 23, '14 55.76 kg.	Prelim.	12:07	.....	.....	..	.....	.....	.....	.....	.....	38.07
	1	1:07	25.02	22.61	.81	30.22	0.187	75.66	62.23	70.20	38.25
	2	2:07	25.51	23.48	.79	28.78	0.187	78.30	64.70	81.43	38.62
	3	3:07	27.24	25.59	.77	29.84	0.187	85.03	70.05	71.67	38.88
Edw. B. .... Oct. 26, '14 56.10 kg.	Prelim.	11:24	.....	.....	..	.....	.....	.....	.....	.....	37.54
	1	12:24	23.13	19.58	.86	31.21	0.264	66.36	61.58	66.23	37.65
	2	1:24	24.87	23.79	.76	29.49	0.264	78.72	60.08	67.98	37.83
	3	2:24	25.18	22.90	.80	30.36	0.264	76.47	65.45	73.34	38.01
	4	3:24	26.12	23.21	.82	31.13	0.264	77.87	70.55	84.46	38.32
Edw. B. .... Oct. 27, '14 56.84 kg.	Prelim.	11:20	.....	.....	..	.....	.....	.....	.....	.....	37.40
	1	12:20	24.80	21.91	.82	30.89	0.552	73.08	60.09	59.69	37.46
	2	1:20	23.76	22.13	.78	29.26	0.552	73.01	61.33	70.63	37.68
	3	2:20	23.24	22.30	.76	28.83	0.552	73.13	63.78	73.06	37.91
Edw. B. .... Nov. 4, '14 58.72 kg.	Prelim.	11:15	.....	.....	..	.....	.....	.....	.....	.....	37.16
	1	12:15	24.00	19.79	.88	31.79	0.337	67.32	64.06	64.69	37.18
	2	1:15	25.03	21.77	.84	31.06	0.337	73.17	65.16	69.21	37.27
	3	2:15	24.89	21.98	.82	31.62	0.337	73.72	70.13	74.19	37.36
Edw. B. .... Nov. 6, '14 59.78 kg.	Prelim.	11:15	.....	.....	..	.....	.....	.....	.....	.....	38.84
	1	12:15	26.21	23.22	.82	27.40	0.336	77.76	62.39	81.16	39.28
	2	1:15	26.65	23.45	.83	28.17	0.336	78.07	64.20	69.44	39.41
	3	2:15	26.61	23.39	.82	30.30	0.336	78.33	68.49	72.75	39.52
Edw. B. .... Nov. 10, '14 56.87 kg.	Prelim.	11:15	.....	.....	..	.....	.....	.....	.....	.....	40.32
	1	12:15	30.59	30.14	.74	35.32	0.525	98.74	88.56	86.50	40.33
	2	1:15	29.52	27.49	.78	36.30	0.525	90.99	87.53	91.26	40.43
	3	2:15	30.25	.....	..	39.54	0.525	.....	94.67	86.34	40.26
John K. .... Dec. 15, '14 68.81 kg.	Prelim	11:56	.....	.....	..	.....	.....	.....	.....	.....	39.00
	1	12:56	30.97	28.17	.80	34.02	1.258	92.29	85.30	94.23	39.26
	2	1:56	30.59	30.08	.74	39.95	1.258	97.14	91.58	87.82	39.22

Surface Temp., C.	Average Pulse	Work Adder., Cm.	Non-Protein, R. Q.	Per Cent. Calories from			Calories Per Hour		Remarks
				Protein	Fat	Carbohyd.	Per Kg.	Per Sq. M.	
.....	81	31.4	.80	17	57	26	1.69	45.50	Basal. Somewhat restless.
.....	98	16.2	.85	17	43	40	1.68	45.11	
.....	..	18.5	.80	17	57	26	1.70	45.72	
.....	82	22.0	.95	26	13	61	1.45	38.79	Basal.
.....	102	30.0	.85	22	40	38	1.74	46.34	
.....	95	17.0	.81	22	50	28	1.68	44.83	
.....	76	21.0	.90	20	28	52	1.25	37.42	Basal.
.....	81	19.0	.83	20	46	34	1.26	37.81	
.....	80	13.0	.89	19	32	49	1.32	39.55	
35.75						.			
36.05	79	16.0	....	..	..	..	1.75	44.32	Basal. Restless. Second period ½ hr. long because patient voided in bed.
36.10	76	9.0	....	..	..	..	1.66	41.93	
.....	118	12.0	.81	7	49	44	1.36	42.10	Basal.
.....	115	17.0	.79	6	67	27	1.40	43.57	
.....	116	24.0	.77	6	73	21	1.53	47.32	
.....	105	11.0	.87	11	39	50	1.18	36.78	10:25 a. m., 79 gm. olive oil = 750 calories.
.....	117	10.0	.76	9	74	17	1.40	43.64	
.....	126	10.0	.80	9	62	29	1.36	42.39	
.....	123	15.0	.82	9	56	35	1.39	43.17	
.....	106	14.0	.83	19	47	34	1.29	40.16	Basal.
.....	109	22.0	.78	19	61	20	1.29	40.12	
.....	107	14.0	.75	19	69	12	1.29	40.18	
.....	102	10.6	.90	13	30	57	1.15	36.19	Basal.
.....	104	14.0	.84	12	48	40	1.25	39.34	
.....	105	25.0	.83	12	51	37	1.26	39.64	
.....	...	31.0	.82	11	54	35	1.30	41.32	Basal. Rising temp.
.....	124	5.0	.83	11	51	38	1.31	41.48	
.....	124	12.0	.82	11	54	35	1.31	41.62	
.....	141	24.0	.73	14	79	7	1.74	54.31	Basal. Very high temp. Mildly delirious.
.....	142	30.5	.78	15	64	21	1.60	50.05	
.....	140	16.0++							
.....	62	16.0	.80	36	43	21	1.45	46.94	Basal.
.....	63	14.0	.70	34	66	0	1.52	49.41	

TABLE 6.—CLINICAL DATA

CHARLES F.

Date, 1913	Food			Food N., Gm.	Urine N., Gm.	Excreta N., Gm.	Nitrogen Bal., Gm.	Body Wt., Kg.	Urine Vol., C.c.
	Total Calories	Carbohydrate, Gm.	Fat, Gm.						
Nov. 6....	1,465	88.0	96.0	8.3	14.68	15.51†	—7.21	58.56	1,270
Nov. 7....	.....	.....	.....	....	15.52	.....	....	.....	1,600
Nov. 8....	1,855	116.0	123.0	9.1	21.10	22.01	—12.91	.....	2,300
Nov. 9....	2,065	130.0	135.0	10.8	20.45	21.53	—10.73	.....	1,870
Nov. 10....	1,088	80.0	69.0	4.4	16.22	16.66	—12.26	57.76	1,205
Nov. 11....	2,027	214.0	87.0	13.2	22.28	23.60	—10.40	58.25	1,740
Nov. 12....	2,610	251.0	144.0	9.8	18.92	19.90	—10.10	.....	2,110
Nov. 13....	2,255	218.0	118.0	10.2	17.37	18.39	—8.19	57.88	1,900
Nov. 14....	1,399	203.0	50.0	3.8	16.03	16.41	—12.61	57.60	1,235
Nov. 15....	1,286	148.0	60.0	4.6	18.54	19.00	—14.40	56.86	1,270
Nov. 16....	1,440	151.0	72.0	5.7	18.89	19.46	—13.76	.....	1,960
Nov. 17....	1,492	128.0	83.0	7.6	17.82	18.58	—10.98	.....	2,110
Nov. 18....	1,749	133.0	107.0	8.1	20.34	21.15	—13.05	56.01	1,470
Nov. 19....	1,019	63.0	68.0	5.2	22.13	22.65	—17.45	.....	1,360
Nov. 20....	1,323	93.0	76.0	8.7	22.41	23.28	—14.58	.....	1,380
Nov. 21....	1,426	74.0	98.0	8.1	22.81	23.62	—15.52	.....	1,380
Nov. 22....	1,970	122.0	128.0	10.9	20.50	21.59	—10.69	.....	1,900
Nov. 23....	1,787	112.0	115.0	10.6	18.16	19.22	—8.62	.....	1,680
Nov. 24....	1,696	117.0	101.0	10.4	18.16	19.20	—8.80	52.02	1,580
Nov. 25....	2,443	159.0	155.0	13.8	18.95	20.33	—6.53	.....	1,910
Nov. 26....	2,595	174.0	160.0	15.4	18.92	20.46	—5.06	51.48	20.50
Nov. 27....	2,345	173.0	142.0	12.3	18.41	19.64	—7.34	.....	1,920
Nov. 28....	2,646	223.0	150.0	13.1	16.65	17.96	—4.86	50.98	2,120
Nov. 29....	* 1,903	129.0	126.0	7.8	13.91	14.69	—6.89	50.29	1,150
Nov. 30....	2,825	236.0	158.0	15.2	15.58	17.10	—1.90	.....	1,700
Dec. 1....	3,491	314.0	195.0	14.9	14.12	15.61	—0.71	50.50	1,760
Dec. 2....	3,126	310.0	160.0	14.3	12.33	13.76	+0.54	.....	1,480+
Dec. 3....	2,595	279.0	118.0	13.7	11.99	13.36	+0.34	50.79	1,600
Dec. 4....	3,408	382.0	150.0	17.4	12.69	14.43	+2.96	.....	1,480
Dec. 5....	2,683	362.0	87.0	15.0	12.05	13.55	+1.45	.....	1,580
Dec. 6....	2,827	390.0	88.0	15.9	12.67	14.26	+1.64	49.83	1.401
Dec. 7....	3,223	446.0	106.0	16.0	12.72	14.32	+1.68	49.83	1,740
Dec. 8....	2,182	346.0	94.0	20.0	16.27	18.27	+1.73	51.02	1,220
Dec. 9....	2,426	308.0	91.0	12.5	12.04	13.29	—0.79	50.41	695
Dec. 10....	2.905	432.0	88.0	12.3	10.01	11.24	+1.06	50.80	1,100
Dec. 11....	3,485	503.0	107.0	16.7	9.47	11.14	+5.56	.....	1,640
Dec. 12....	3,768	556.0	115.0	16.3	9.92	11.55	+4.75	.....	1,500
Dec. 13....	4,025	619.0	129.0	18.2	10.48	12.30	+5.90	53.16	1,880
Dec. 14....	3,660	549.0	105.0	16.8	10.59	12.27	+4.53	.....	1,470

* Estimate heat production 1,725.

TABLE 6.—Clinical Data—(*Continued*)

Charles F.—(*Continued*)

Date, 1913	Food			Food N., Gm.	Urine N., Gm.	Excreta N., Gm.	Nitrogen Bal., Gm.	Body Wt., Kg.	Urine Vol., C.c.
	Total Calories	Carbohydrate, Gm.	Fat, Gm.						
Dec. 15....	4.032	585.0	124.0	18.8	9.93	11.81	+6.99	52.81	1,330+
Dec. 16....	3.921	573.0	118.0	18.6	11.67	13.53	+5.07	54.05	1,280
Dec. 17....	3,539	510.0	109.0	16.9	11.15	12.84	+4.06	.....	1,470
Dec. 18....	3,869	572.0	113.0	18.2	11.54	13.36	+4.84	.....	1,800
Dec. 19....	4,085	630.0	112.0	17.9	10.39	12.18	+5.72	.....	1,500
Dec. 20....	3,901	599.0	105.0	18.5	11.04	12.89	+5.61	.....	1,760
Dec. 21....	4.017	620.0	105.0	19.3	11.43	13.36	+5.94	.....	1,850
Dec. 22....	3,351	282.0	189.0	17.1	12.33	14.04	+3.06	55.43	1,700
Dec. 23....	3,722	241.0	249.0	16.4	11.46	13.10	+3.30	.....	1,180
Dec. 24....	3,739	228.0	254.0	17.5	13.14	14.89	+2.61	.....	1,440
Dec. 25....	.....	.....	.....	....	9.28	.....	....	.....	1.300
Dec. 26....	2,122	153.0	137.0	12.4	9.40	10.64	+1.76	55.91	1,940
Dec. 27....	3,636	254.0	224.0	20.0	12.16	14.16	+5.84	.....	1,600
Dec. 28....	3,614	247.0	226.0	19.4	12.86	14.80	+4.60	.....	1,640
Dec. 29....	3,818	221.0	259.0	19.0	12.78	14.66	+4.34	.....	1,820
Dec. 30....	4,899	256.0	347.0	24.2	11.49	13.91	+10.29	.....	1,480
Dec. 31....	2,131	202.0	103.0	13.3	11.53	12.86	+0.44	56.43	1,571
1914 Jan. 1....	3,949	347.0	161.0	18.6	11.54	13.40	+5.20	.....	1,000
Jan. 2....	3,587	287.0	202.0	22.0	8.10	10.30	+11.70	.....	860

† Excreta nitrogen estimated as urine nitrogen + 10 per cent. of food nitrogen.

TABLE 6.—Clinical Data—(*Continued*)

Morris S.

Date, 1913	Estimated Heat Production per 24 Hrs.	Food: Total Calories	Food: Carbohydrate, Gm.	Food: Fat, Gm.	Food N., Gm.	Urine N., Gm.	Feces N., Gm.	Excreta N., Gm.	Nitrogen Bal., Gm.	Body Weight Kg.	Urine Volume, C.c.	Feces Fat
Oct. 23	.....	2,962	419.0	76.0	20.8	15.13	3.1*	18.2	+2.6	49.69	1,280	
Oct. 24	2,376	1,259	169.0	28.0	11.8	19.56	1.7*	21.3	—9.5	51.50	2,350	
Oct. 25	2,299	2,371	364.0	36.0	21.3	13.59	3.2*	16.8	+4.5	51.22	1,710	
Oct. 26	.....	4,375	471.0	101.0	19.5	20.34	2.9	23.2	—3.7	.....	3,000	
Oct. 27	.....	3,194	321.0	152.0	18.2	21.60	2.7	24.3	—6.1	51.26	2,170	
Oct. 28	2,200	2,332	242.0	116.0	10.0	17.43	1.5	18.9	—8.9	51.18	1,390	
Oct. 29	2,228	2,876	258.0	150.0	16.4	20.38	2.5	22.9	—6.5	50.17	1,465	
Oct. 30	.....	3,031	318.0	141.0	15.5	18.72	2.31	21.03	—5.5	49.85	1,580	9.74
Oct. 31	2,225	2,784	224.0	149.0	18.0	22.28	2.31	24.59	—6.6	50.32	1,830	9.74
Nov. 1	.....	3,089	327.0	147.0	14.8	17.48	2.31	19.79	—5.0	49.82	1,600	9.74
Nov. 2	.....	3,039	324.0	142.0	15.2	16.76	2.31	19.07	—3.9	.....	1,600	9.74
Nov. 3	2,205	3,039	324.0	142.0	15.2	17.39	2.31	19.70	—4.5	48.83	1,370	9.74
Nov. 4	.....	3,039	324.0	142.0	15.2	15.86	2.31	18.17	—3.0	49.63	1,220	9.74
Nov. 5	2,104	3,024	324.0	139.0	15.4	15.57	2.31	17.88	—2.5	48.48	1,160	9.74
Nov. 6	.....	3,039	325.0	147.0	15.4	13.51	2.3	15.8	—0.4	49.03	1,310	
Nov. 7	.....	3,034	327.0	140.0	15.0	12.39	2.3	14.7	+0.3	.....	1,220	
Nov. 8	.....	3,018	319.0	142.0	15.0	11.24	2.3	13.5	+1.5	48.73	1,310	
Nov. 9	.....	3,048	321.0	144.0	15.4	11.71	2.3	14.0	+1.4	.....	1,240	
Nov. 10	.....	2,969	305.0	144.0	14.9	12.05	2.2	14.3	+0.6	.....	2,000	
Nov. 11	.....	3,004	324.0	140.0	14.8	10.23	2.2	12.4	+2.4	48.05	1,220	
Nov. 12	.....	2,998	314.0	142.0	15.2	12.78	2.3	15.1	+0.1	.....	1,380	
Nov. 13	.....	2,998	314.0	142.0	15.2	11.43	2.3	13.7	+1.5	.....	1,480	
Nov. 14	....	3,181	331.0	142.0	15.4	10.54	2.3	12.8	+2.6	.....	1,890	
Nov. 15	.....	2,994	313.0	142.0	15.2	10.42	2.3	12.7	+2.5	.....	2,000	
Nov. 16	.....	3,134	341.0	144.0	15.3	11.44	2.3	13.7	+1.6	.....	1,820	
Nov. 17	1,875	3,076	333.0	142.0	15.2	13.32	2.3	15.6	—0.4	48.80	1,690	
Nov. 18	2,022	1,987	217.0	95.0	8.0	15.19	1.2	16.4	—8.4	49.06	1,440	
Nov. 19	.....	1,355	148.0	61.0	7.7	15.47	1.2	16.7	—9.0	.....	2,280	
Nov. 20	.....	1,727	199.0	79.0	7.0	15.13	1.1	16.2	—9.2	.....	1,300	
Nov. 21	.....	1,805	171.0	95.0	8.4	14.74	1.3	16.0	—7.6	.....	900	
Nov. 22	.....	2,292	153.0	152.0	10.1	14.85	1.5	16.4	—6.3	.....	800	
Nov. 23	.....	2,392	192.0	132.0	10.7	15.69	1.6	17.3	—6.6	.....	840	
Nov. 24	2,282	2,016	173.0	117.0	8.5	13.08	1.3	14.4	—5.9	46.98	890	
Nov. 25	2,301	2,298	187.0	123.0	15.1	13.66	2.3	16.0	—0.9	47.47	925	
Nov. 26	2,217	2,087	172.0	126.0	8.0	10.32	1.2	11.5	—3.5	45.84	780	
Nov. 27	.....	2,747	242.0	148.0	14.8	18.58	2.2	20.8	—6.0	.....	820	
Nov. 28	.....	2,741	256.0	140.0	15.0	12.44	2.3	14.7	+0.3	47.26	980	
Nov. 29	.....	3,083	324.0	142.0	15.0	11.82	2.3	14.1	+0.9	.....	1,370	
Nov. 30	.....	3,153	334.0	147.0	16.0	10.76	2.4	13.2	+2.8	.....	1,060	
Dec. 1	.....	3,091	333.0	142.0	15.7	9.81	2.4	12.2	+3.5	47.08	1,180	
Dec. 2	.....	3,090	340.0	142.0	15.3	9.69	2.3	12.0	+3.3	.....	1,660+	

* Feces analyzed October 30 to November 5. Feces nitrogen averaged 14.8 per cent. of food nitrogen. On all other days the feces nitrogen was calculated as 15 per cent. of food nitrogen.

TABLE 6.—Clinical Data—(*Continued*)

Morris S.—(*Continued*)

Date, 1913	Estimated Heat Production per 24 Hrs.	Food			Food N., Gm.	Urine N., Gm.	Feces N., Gm.*	Excreta N., Gm.*	Nitrogen Balance, Gm.	Body Weight, Kg.	Urine Volume, C.c.	Feces Fat
		Total Calories	Carbohydrate, Gm.	Fat, Gm.								
Dec 3	.....	3,189	356.0	141.0	16.0	8.52	2.4	10.9	+5.1	47.31	930	
Dec. 4	.....	3,118	250.0	180.0	16.0	8.70	2.4	11.1	+4.9	.....	1,500	
Dec. 5	.....	2,977	156.0	209.0	15.0	8.74	2.3	11.0	+4.0	.....	1,520	
Dec. 6	.....	2,998	161.0	209.0	15.0	9.75	2.3	12.1	+2.9	46.55	1,340	
Dec. 7	.....	3,297	202.0	221.0	16.0	9.08	2.4	11.5	+4.5	.....	1,640	
Dec. 8	.....	3,914	206.0	289.0	14.9	8.55	2.2	10.8	+4.1	.....	1.340	
Dec. 9	.....	3,989	219.0	290.0	15.2	7.65	2.3	10.0	+5.2	47.53	1,140	
Dec. 10	.....	3,989	219.0	290.0	15.2	8.85	2.3	11.2	+4.0	.....	1,550	
Dec. 11	.....	3,989	219.0	290.0	15.2	9.31	2.3	11.6	+3.6	48.46	1,850	
Dec. 12	1,857	3,552	222.0	226.0	21.3	9.87	3.2	13.1	+8.2	48.64	1,700	
Dec. 13	1,604	2,925	395.0	104.0	13.1	12.64	2.0	14.6	—1.5	48.10	1,935	
Dec. 14	.....	3,256	475.0	95.0	16.5	9.47	2.5	12.0	+4.5	.....	1,100	
Dec. 15	1,723	3,117	511.0	74.0	13.0	8.68	2.0	10.7	+2.3	47.87	1,229	
Dec. 16	1,703	2,132	275.0	76.0	11.6	10.24	1.7	11.9	—0.3	47.91	802	
Dec. 17	.....	3,985	440.0	193.0	15.5	9.30	2.3	11.6	+3.9	.....	1,240	
Dec. 18	.....	3,499	256.0	224.0	14.4	10.82	2.2	13.0	+1.4	.....	1,670	
Dec. 19	2,058	2,868	248.0	173.0	9.6	11.34	1.4	12.7	—3.1	48.34	1,282	
Dec. 20	2,081	2,748	150.0	190.0	14.1	13.41	2.1	15.5	—1.4	48.55	1,343	
Dec. 21	.....	3,426	204.0	232.0	16.0	17.32	2.4	19.7	—3.7	48.55	1,560	
Dec. 22	2,217	3,034	345.0	140.0	12.2	14.42	1.8	16.2	—4.0	48.50	1,223	
Dec. 23	1,982	2,499	121.0	186.0	10.7	11.94	1.6	13.5	—2.8	48.54	883	
Dec. 24	.....	3,357	206.0	225.0	16.5	13.06	2.5	15.6	+0.9	.....	1,480	
Dec. 25	.....	.....	.....	.....	....	10.90	...	....	.....	.....	1,200	
Dec. 26	.....	3,560	189.0	253.0	17.1	10.48	2.6	13.1	+4.0	49.70	1,680	
Dec. 27	.....	3,180	159.0	227.0	16.4	11.10	2.5	13.6	+2.8	.....	1,930	
Dec. 28	.....	3,128	157.0	224.0	15.5	11.43	2.3	13.7	+1.8	.....	1,740	
Dec. 29	.....	3,109	157.0	222.0	15.5	11.77	2.3	14.1	+1.4	.....	1,380	
Dec. 30	.....	3,277	170.0	235.0	15.5	11.72	2.3	14.0	+1.5	.....	1,710	
Dec. 31	.....	2,990	293.0	143.0	17.9	12.61	2.7	15.3	+2.6	.....	1,600	
1914 Jan. 1	.....	2,991	256.0	166.0	15.4	12.11	2.3	14.4	+1.0	.....	2,120	
Jan. 2	1,567	2,078	141.0	132.0	10.7	10.01	1.6	11.6	—0.9	49.22	1,340	
Jan. 3	.....	3,051	158.0	216.0	15.6	12.27	2.3	14.6	+1.0	.....	2,160	
Jan. 4	.....	3,070	162.0	216.0	15.7	10.40	2.4	12.8	+2.9	.....	1,730	
Jan. 5	.....	.....	.....	.....	....	11.21	...	....	.....	.....	1,580	
Jan. 6	.....	3,044	158.0	215.0	15.5	12.69	2.3	15.0	+0.5	.....	2,330	
Jan. 7	.....	3,045	158.0	215.0	15.5	11.66	2.3	14.0	+1.5	.....	1,800	
Jan. 8	.....	3,068	162.0	215.0	15.6	11.77	2.3	14.1	+1.5	.....	1,460	
Jan. 9	.....	3,063	162.0	215.0	15.6	11.66	2.3	14.0	+1.6	.....	1,660	
Jan. 10	.....	3,475	268.0	208.0	17.3	12.10	2.6	14.7	+2.6	.....	1,460	
Jan. 11	.....	3,739	354.0	191.0	19.8	12.22	3.0	15.2	+4.6	.....	1,560	
Jan. 12	.....	3,551	344.0	177.0	19.5	12.61	2.9	15.5	+4.0	.....	2,350	
Jan. 13	.....	4,198	382.0	222.0	22.1	11.49	3.3	14.8	+7.3	.....	1,520	

* Excreta nitrogen estimated as urine nitrogen + 15 per cent of food nitrogen.

TABLE 6.—Clinical Data—(*Continued*)

Howard F.

Date, 1913	Food			Food N., Gm.	Urine N., Gm.	Excreta N., Gm.	Nitrogen Bal., Gm.*	Body Wt., Kg.	Urine Vol., C.c.
	Total Calories	Carbohydrate, Gm.	Fat, Gm.						
Nov. 6....	1,264	83.0	81.0	6.7	12.83	13.50	—6.80	36.06	970
Nov. 7....	918	62.0	59.0	4.4	12.05	12.49	—8.09	35.74	640
Nov. 8....	1,538	87.0	107.0	7.0	12.75	13.45	—6.45	35.79	840
Nov. 9....	1,454	106.0	88.0	7.7	12.61	13.38	—5.68	.....	760
Nov. 10....	1,401	115.0	78.0	8.1	12.67	13.48	—5.38	.....	680
Nov. 11....	925	93.0	38.0	7.5	13.79	14.54	—7.04	34.60	750
Nov. 12....	950	98.0	40.0	7.3	13.42	14.15	—6.85	35.01	830
Nov. 13....	1,260	134.0	60.0	5.8	12.52	13.10	—7.30	34.22	610
Nov. 14....	580	52.0	30.0	3.4	10.42	10.76	—7.36	.....	500
Nov. 15....	1,152	83.0	69.0	6.6	11.10	11.76	—5.16	33.36	900
Nov. 16....	1.096	150.0	40.0	4.4	9.98	10.42	—6.02	.....	500
Nov. 17....	1,462	123.0	83.0	7.2	9.30	10.02	—2.82	33.12	400
Nov. 18....	1,588	128.0	91.0	8.5	10.20	11.05	—2.55	32.93	590
Nov. 19....	984	63.0	62.0	5.7	10.65	11.22	—5.52	.....	780
Nov. 20....	1,288	74.0	75.0	7.3	10.25	10.98	—3.68	32.57	550
Nov. 21....	1,466	91.0	95.0	8.1	11.32	12.13	—4.03	.....	700
Nov. 22....	1,198	73.0	94.0	8.8	11.12	12.00	—3.20	.....	800
Nov. 23....	1,789	92.0	121.0	11.6	11.15	12.31	—0.71	.....	660
Nov. 24....	1,846	146.0	145.0	10.6	10.82	11.88	—1.28	.....	820
Nov. 25....	2,060	138.0	129.0	11.4	9.81	10.95	+0.45	32.14	940
Nov. 26....	2,686	176.0	168.0	15.7	10.42	11.99	+3.71	.....	780
Nov. 27....	2,240	211.0	118.0	10.9	9.47	10.56	+0.34	.....	570
Nov. 28....	2,742	245.0	145.0	15.0	9.98	11.48	+3.52	32.25	920
Nov. 29....	2,581	211.0	152.0	11.9	8.52	9.71	+2.19	.....	620
Nov. 30....	2,922	273.0	153.0	14.8	9.53	11.01	+3.79	.....	1,220
Dec. 1....	2,581	309.0	112.0	10.6	7.77	8.83	+1.77	.....	870
Dec. 2....	2,298	247.0	110.0	10.0	7.69	8.69	+1.31	33.09	900
Dec. 3....	3,689	423.0	163.0	17.2	9.25	10.97	+6.23	.....	900
Dec. 4....	3,627	441.0	147.0	17.7	9.00	10.77	+6.93	.....	1.130
Dec. 5....	2,671	337.0	81.0	21.0	13.01	15.11	+5.89	34.77	1,500
Dec. 6....	2,476	333.0	83.0	12.9	9.20	10.49	+2.41	33.81	775
Dec. 7....	3,621	496.0	119.0	19.0	10.45	12.35	+6.65	.....	1,500
Dec. 8....	3,391	434.0	112.0	17.8	9.89	11.67	+6.13	.....	1,270+
Dec. 9....	3,042	386.0	108.0	18.0	10.73	12.53	+5.47	35.51	1,300
Dec. 10....	2,986	394.0	101.0	16.8	10.51	12.19	+4.61	.....	1.450
Dec. 11....	3,149	405.0	114.0	17.8	10.79	12.57	+5.23	35.99	1,450
Dec 12....	3,100	417.0	101.0	17.5	10.36	12.11	+5.39	.....	1,610
Dec. 13....	3,544	472.0	122.0	18.5	10.03	11.88	+6.62	36.65	1,280

TABLE 6.—CLINICAL DATA—(*Continued*)

HOWARD F.—(*Continued*)

Date, 1913	Food			Food N., Gm.	Urine N., Gm.	Excreta N., Gm.	Nitrogen Bal., Gm.*	Body Wt., Kg.	Urine Vol., C.c.
	Total Calories	Carbohydrate, Gm.	Fat, Gm.						
Dec. 14....	3,338	402.0	133.0	17.8	11.01	12.79	+5.01	.....	1,880
Dec. 15....	3,280	510.0	130.0	19.2	12.98	14.90	+4.30	37.54	1,890+
Dec. 16....	3,511	444.0	129.0	19.2	13.28	15.20	+4.00	.....	1,580
Dec. 17....	3,170	345.0	139.0	18.0	9.95	11.75	+6.25	39.10	1,720
Dec. 18....	2,008	248.0	78.0	10.5	8.57	9.62	+0.88	37.17	1,600
Dec. 19....	3,550	411.0	144.0	20.3	11.89	13.92	+6.38	.....	2.050
Dec. 20....	2,671	110.0	197.0	15.0	8.10	9.60	+5.40	.....	1,540
Dec. 21....	2,383	104.0	175.0	12.6	10.65	11.91	+0.69	.....	1,250
Dec. 22....	2,936	159.0	198.0	17.3	13.23	14.96	+2.34	37.21	1,150
Dec. 23....	3,520	239.0	235.0	13.9	9.19	10.58	+3.32	.....	1,200
Dec 24....	3,605	219.0	243.0	17.4	10.70	12.44	+4.96	.....	1,700
Dec. 25....	.....	.....	.....	....	10.42	.....	......	.....	1,370
Dec. 26....	3,152	219.0	199.0	15.6	9.77	11.33	+4.27	39.46	2,100
Dec. 27....	3,303	257.0	196.0	16.8	10.03	11.71	+5.09	.....	1.600
Dec. 28....	2,946	200.0	186.0	15.4	7.51	9.05	+6.35	.....	1.080
Dec. 29....	4,199	265.0	278.0	20.5	10.87	12.92	+7.58	.....	1,640
Dec. 30....	2,325	165.0	145.0	11.4	7.81	8.95	+2.45	39.39	987
Dec. 31....	3,569	317.0	192.0	18.5	11.77	13.62	+4.88	.....	1,500
1914									
Jan. 1....	2,912	236.0	169.0	14.5	9.02	10.47	+4.03	.....	1,600
Jan. 2....	2,891	224.0	156.0	16.0	8.74	10.34	+5.66	.....	1,540

* Excreta nitrogen estimated as urine nitrogen + 10 per cent of food nitrogen.

TABLE 6.—Clinical Data—(*Continued*)

Karl S.

Date, 1914	Estimated Heat Production per 24 Hrs.	Food			Food N., Gm.	Urine N., Gm.	Feces N., Gm.	Excreta N., Gm.*	Nitrogen Balance, Gm.	Body Weight, Kg.	Urine Volume, C.c.
		Total Calories	Carbohydrate, Gm.	Fat, Gm							
Jan. 3	.....	2,038	104.0	145.0	10.8	20.52	...	21.60	—10.80	.....	880
Jan. 4	.....	1,301	113.0	71.0	6.9	21.72	...	22.41	—15.51	.....	1,240
Jan. 5	2,579	1,119	95.0	64.0	5.4	.....	...	.....	......	54.67	725
Jan. 6	2,707	1,332	167.0	32.0	13.6	22.36	...	23.72	—10.12	54.31	1,010
Jan. 7	.....	1,942	93.2	136.0	11.3	.....	...	.....	......	.....	810
Jan. 8	.....	2,331	136.0	156.0	12.5	16.03	...	17.28	—4.78	.....	860
Jan. 9	.....	1,892	114.0	126.0	9.8	23.84	...	24.82	—15.02	52.99	1,700
Jan. 10	.....	2,910	223.0	174.0	14.6						
Jan. 11	.....	3,018	318.0	139.0	16.4						
Jan. 12	.....	3,017	322.0	138.0	16.2	18.15	1.6	19.8	—3.6	.....	2,310
Jan. 13	.....	2,966	326.0	128.0	17.2	13.94	1.7	15.6	+1.6	.....	1,820
Jan. 14	.....	2,802	313.0	118.0	16.4	17.06	1.6	18.7	—2.3	.....	1,830
Jan. 15	.....	3,129	323.0	149.0	16.2	18.65	1.6	20.3	—4.1	52.74	1,920
Jan. 16	2,208	2,448	226.0	132.0	11.5	19.11	1.2	20.3	—8.8	52.24	1,960
Jan. 17	.....	3,398	340.0	166.0	17.9	19.16	1.8	21.0	—3.1	.....	1,940
Jan. 18	.....	3,138	329.0	145.0	17.1	17.26	1.7	19.0	—1.9	.....	1,920
Jan. 19	1,651	2,795	268.0	145.0	13.6	14.72	1.4	16.1	—2.5	51.21	1,260
Jan. 20	.....	2,965	313.0	138.0	15.7	14.51	1.6	16.1	—0.4	.....	1,550
Jan. 21	1,798	2,912	315.0	129.0	16.3	17.57	1.6	19.2	—2.9	51.52	1,870
Jan. 22	1,512	2,605	253.0	133.0	12.8	13.25	1.3	14.6	—1.8	51.18	1,194
Jan. 23	.....	3,033	324.0	140.0	15.9	11.99	1.6	13.6	+2.3	.....	1,360
Jan. 24	.....	2,982	315.0	138.0	15.8	13.06	1.6	14.7	+1.1	.....	1,960
Jan. 25	.....	2,987	315.0	139.0	15.8	13.17	1.6	14.8	+1.0	.....	1,400
Jan. 26	.....	3,541	408.0	155.0	16.7	12.64	1.7	14.3	+2.4	54.64	1,620
Jan. 27	.....	3,999	439.0	191.0	16.3	13.06	1.6	14.7	+1.6	.....	1,460
Jan. 28	.....	4,025	439.0	194.0	16.3	11.88	1.6	13.5	+2.8	.....	1,280
Jan. 29	.....	3,975	438.0	190.0	16.1	11.32	1.6	12.9	+3.2	52.54	1,450
Jan. 30	.....	3,991	439.0	191.0	16.2	10.65	1.6	12.3	+3.9	.....	1,500
Jan. 31	.....	3,922	418.0	193.0	16.2	10.93	1.6	12.5	+3.7	.....	1,400
Feb. 1	.....	3,940	418.0	194.0	16.3	10.63	1.6	12.2	+4.1	.....	1,500
Feb. 2	.....	3,808	419.0	180.0	16.0	11.21	1.6	12.8	+3.2	.....	1,910
Feb. 3	.....	3,808	419.0	180.0	16.0	11.15	1.6	12.8	+3.2	.....	1,980
Feb. 4	.....	3,971	442.0	188.0	16.0	10.87	1.6	12.5	+3.5	.....	1,870
Feb. 5	.....	3,974	438.0	191.0	16.0	9.29	1.6	10.9	+5.1	.....	1,640
Feb. 6	1,916	3,232	330.0	165.0	13.3	10.24	1.3	11.5	+1.8	53.33	1,360
Feb. 7	1,965	3,526	387.0	148.0	22.1	.....	2.2	17.3	+4.8	54.48	2,300
Feb. 8	.....	4,018	474.0	178.0	16.3	11.67	1.6	13.3	+3.0	.....	1,440

* Excreta nitrogen estimated as urine nitrogen + 10 per cent. of food nitrogen.

TABLE 6.—Clinical Data—(*Continued*)

Thomas B.

Date 1913	Temperature		Food			Food N., Gm.	Urine N., Gm.	Feces N., Gm.	Excreta N., Gm.	Nitrogen Balance, Gm.	Body Weight, Kg.	Urine Volume, C.c.	Feces Fat
	Max.	Min.	Total Calories	Carbo-hydrate, Gm.	Fat, Gm.								
Oct. 7	103.0	101.4	3,052	168.0	212.0	15.0	24.55	2.09	26.64	—11.64	76.08	1,240	9.19
Oct. 8	103.6	101.2	3,010	163.0	210.0	15.0	25.50	2.09	27.59	—12.59	75.61	1,270	9.19
Oct. 9	104.0	101.6	3,010	163.0	210.0	15.0	21.29	2.09	23.38	—8.38	75.73	1,120	9.19
Oct. 10	103.6	101.6	3.030	163.0	212.0	15.0	23.67	2.09	25.76	—10.76	76.02	1,740	9.19
Oct. 11	103.0	101.0	3.014	479.0	71.0	14.9	20.12	1.89	22.01	—7.11	74.85	1,500	5.80
Oct. 12	102.8	101.6	3,018	480.0	71.0	15.0	17.77	1.89	19.66	—4.66	.....	1,960	5.80
Oct. 13	102.4	100.6	3,014	479.0	71.0	14.9	18.77	1.89	20.66	—5.76	74.24	1,980	5.80
Oct. 14	103.0	100.0	3.045	173.0	212.0	14.2	18.21	1.28	19.49	—5.29	74.38	1,220	5.02
Oct. 15	102.2	98.6	2,570	130.0	187.0	11.7	18.61	1.28	19.89	—8.19	.....	1,040	5.02
Oct. 16	101.0	99.4	3,058	168.0	212.0	15.4	21.04	1,28	22.32	—6.92	.....	1,010	5.02
Oct. 17	101.6	99.4	3,211	484.0	78.0	15.6	17.79	....	19.35*	—3.75	73.10	1,120	
Oct. 18	100.6	99.0	2,998	476.0	71.0	15.0	15.69	....	17.19	—2.19	.....	1,100	
Oct. 19	99.6	98.6	3,019	481.0	71.0	15.0	15.30	....	16.80	—1.80	.....	1,220	
Oct. 20	99.6	98.6	3,002	468.0	75.0	15.0	15.24	....	16.74	—1.74	72.82	1,880	
Oct. 21	98.6	99.4	2,675	412.0	68.0	13.0	15.75†	....	.....	....	.....	1,610+	(?)
Oct. 22	99.6	98.8	2,943	462.0	71.0	15.0	16.32	....	17.82	—2.82	.....	1,480	
Oct. 23	99.6	98.6	3,062	449.0	76.0	21.2	16.76	....	18.88	+2.32	.....	1,230	
Oct. 24	99.6	98.6	3,396	541.0	60.0	20.0	13.34	....	15.34	+4.66	72.86	1,640	
Oct. 25	99.6	98.6	3,211	493.0	71.0	20.0	16.59	....	18.59	+1.41	.....	1,120	
Oct. 26	99.0	98.2	3,066	164.0	215.0	15.5	18.90	....	20.45	—4.95	.....	1,320	
Oct. 27	99.6	98.4	3,159	164.0	219.0	17.5	17.65	....	19.40	—1.90	.....	2,280	
Oct. 28	99.0	98.2	3,277	182.0	220.0	18.5	14.18	....	16.03	+2.47	73.69	1,220	

† This is the total for 19¾ hours.
* Excreta nitrogen estimated as urine nitrogen + 10 per cent. of food nitrogen.

TABLE 6.—Clinical Data—(*Continued*)

Richard T.

Date 1913	Temperature		Food			Food N., Gm.	Urine N., Gm.	Feces N., Gm.	Excreta N., Gm.	Nitrogen Balance, Gm.	Body Weight, Kg.	Urine Volume, C.c.	Feces Fat
	Max.	Min.	Total Calories	Carbo-hydrate, Gm.	Fat, Gm.								
Oct. 17	103.6	101.4	1.656	248.0	38.0	11.3	13.95	0.84	14.79	—3.49	36.09	2,290	1.63
Oct. 18	104.2	100.8	1,143	115.0	49.0	8.4	12.48	0.84	13.32	—4.92	.....	1,145	1.63
Oct. 19	103.2	100.8	2,131	327.0	49.0	13.0	14.40	0.84	15.24	—2.24	.....	1,720	1.63
Oct. 20	104.0	100.0	2,020	280.0	55.0	14.0	14.53	0.84	15.37	—1.37	.....	1,005	1.63
Oct. 21	102.8	100.0	2,359	360.0	51.0	16.0	15.13	0.84	15.97	+0.03	.....	1,320	1.63
Oct. 22	102.4	99.4	2,092	315.0	46.0	14.7	14.74	0.84	15.58	—0.88	35.57	1,200	1.63
Oct. 23	103.0	99.0	2,576	369.0	67.0	17.4	16.30	0.84	17.14	+0.26	35.70	1,570	1.63
Oct. 24	102.0	99.4	2,153	333.0	35.0	18.0	15.69	0.84	16.53	+1.47	.....	1,340	1.63
Oct. 25	101.0	98.4	2,519	228.0	125.0	16.0	16.32	0.84	17.16	—1.16	.....	1,260	1.63
Oct. 26	100.6	99.0	2,093	115.0	133.0	15.0	16.53	....	* 18.03	—3.03	.....	1,100	
Oct. 27	100.2	98.6	2,163	121.0	136.0	15.7	16.34	....	17.91	—2.21	35.30	1,200	
Oct. 28	99.6	98.6	2,009	124.0	117.0	16.0	16.47	....	18.07	—2.07	35.60	1,460	
Oct. 29	100.0	98.6	3,276	348.0	157.0	15.2	14.01	....	15.53	—0.33	.....	1,370	
Oct. 30	100.0	99.0	2,969	302.0	144.0	15.1	11.77	....	13.28	+1.82	35.38	1,195	
Oct. 31	101.6	99.2	2,954	310.0	142.0	15.5	12.05	....	13.60	+1.90	.....	1,420	
Nov. 1	102.0	100.4	3,069	334.0	142.0	14.5	11.32	....	12.77	+1.73	36.08	1,320	
Nov. 2	102.4	99.6	2,995	325.0	138.0	14.5	11.74	....	13.19	+1.31	.....	1,900	
Nov. 3	101.0	99.6	2,984	316.0	140.0	15.1	11.99	....	13.50	+1.60	36.27	1,270	
Nov. 4	100.2	99.4	3,037	320.0	144.0	15.2	12.22	....	13.74	+1.46	36.42	1,560	

* Excreta nitrogen estimated as urine nitrogen + 10 per cent. of food nitrogen.

TABLE 6.—Clinical Data—(*Continued*)
Edward B.

Date, 1914	Estimated Heat Production per 24 Hrs.	Food			Food N., Gm.	Urine N., Gm.	Excreta N., Gm.*	Nitrogen Balance Gm.	Body Weight, Kg.	Urine Volume, C.c.
		Total Calories	Carbohydrate, Gm.	Fat, Gm.						
Oct. 14	.....	3,901	214.9	284.8	14.5	14.51	15.96	—1.46	56.29	1,180
Oct. 15	.....	4,171	212.9	309.3	16.4	11.39	13.03	+3.4	.....	1.415
Oct. 16	.....	4,003	662.0	97.2	15.0	11.49	12.99	+2.0	56.36	1,665(?)
Oct. 17	.....	1,561	236.3	43.8	7.28	8.65	9.37	—2.09	56.94	1,140
Oct. 18	.....	2,976	94.5	236.9	15.0	11.08	12.58	—2.42	56.01	1,690
Oct. 19	.....	4,217	111.0	362.1	13.9	16.17	17.56	—3.66	56.98	2,230
Oct. 20	.....	4,097	114.9	348.9	14.80	10.96	12.44	+2.36	56.57	1.520
Oct. 21	.....	3,586	518.9	114.7	15.20	9.17	10.69	+4.51	57.21	1,250
Oct. 22	.....	3,076	579.6	54.2	7.68	7.85	8.61	—0.93	56.60	1,170
Oct. 23	2,160	3,462	152.8	269.1	12.90	8.21	9.50	+3.40	55.76	835
Oct. 24	.....	4,072	220.6	299.4	15.0	11.94	13.44	+1.56	56.84	1,465
Oct. 25	.....	4,114	220.9	303.1	15.1	11.20	12.70	+2.40	56.73	1,515
Oct. 26	1,976	2,704	151.4	124.1	6.9	6.75	7.44	—0.54	.....	663
Oct. 27	1,982	3,844	109.1	334.5	11.1	8.61	9.72	+1.38	.....	1,125
Oct. 28	.....	4,056	223.4	295.7	15.2	8.19	9.71	+5.49	57.51	2,155
Oct. 29	.....	4,185	314.8	265.7	16.5	8.70	10.35	+6.15	57.46	1,960
Oct. 30	.....	3,643	364.7	179.0	18.8	10.30	12.18	+6.62	57.83	2.310
Oct 31	.....	3,893	402.5	191.4	18.0	9.72	11.52	+6.48	.....	1.655
Nov. 1	.....	4,394	455.7	218.4	19.3	11.05	12.98	+6.32	58.53	2,450
Nov. 2	.....	4,491	451.6	225.8	21.0	11.80	13.9	+7.1	58.76	1,770
Nov. 3	.....	4,836	491.9	244.6	21.2	12.20	14.32	+6.88	59.52	2,405
Nov. 4	1,936	2,209	209.4	119.7	9.2	9.20	10.12	—0.92	.....	979
Nov. 5	.....	3,960	390.5	195.9	17.0	10.59	12.29	+5.71	.....	1,665
Nov. 6	2,117	1,907	219.5	85.9	8.0	10.96	11.76	—3.76	.....	1,523
Nov. 7	.....	1,006	101.2	49.8	5.05	12.13	12.63	—7.58	59.23	1.075
Nov. 8	.....	398	64.0	11.8	1.08	10.34	10.44	—9.36	.....	665
Nov. 9	.....	617	94.8	20.0	1.68	11.26	11.42	—9.74	57.06	645
Nov. 10	2,632	1,103	104.3	51.2	6.0	14.72	15.32	—9.32	.....	833
Nov. 11	.....	1,646	96.0	84.2	9.7	16.73	17.70	—8.0	57.11	1,230
Nov. 12	.....	2,196	165.9	119.3	10.7	14.79	15.8	—5.1	.....	1,250

* Excreta nitrogen estimated as urine nitrogen + 10 per cent. of food nitrogen.

TABLE 6.—Clinical Data—(*Continued*)
John K.

Date, 1913	Total Calories	Carbohydrate, Gm.	Fat, Gm.	Food N., Gm.	Urine N., Gm.	Excreta N., Gm.	Nitrogen Bal., Gm.	Body Wt., Kg.	Urine Vol., C.c.
Dec. 15....	* 2,194	139.1	148.9	9.3	24.58	25.51	—16.21	63.81	1,152
Dec. 16....	3,309	145.1	246.8	16.3	21.45	23.08	—6.78	63.55	1,180
Dec. 17....	3,521	181.9	258.1	14.6	22.37	23.83	—9.23	63.27	3,110
Dec. 18....	3,205	181.9	223.6	14.8	19.30	20.78	—5.98	63.35	3,040
Dec. 19....	3,788	251.6	249.6	17.0	19.40	21.10	—4.10	63.05	3,230
Dec. 20....	3,916	259.7	257.1	18.0	18.26	20.06	—2.06	62.37	3,460
Dec. 21....	4,134	342.5	238.4	20.0	19.33	21.33	—1.33	63.04	4,285
Dec. 22....	4,558	378.4	267.2	20.4	18.00	20.04	+0.36	62.64	4,255
Dec. 23....	4,838	393.9	285.8	22.0	17.93	22.13	—0.13	63.26	3,210
Dec. 24....	4,450	373.1	259.1	19.9	18.78	20.77	—0.87	63.32	3,350

TABLE 7.—SUMMARY OF CLINICAL CALORIMETRY IN TYPHOID FEVER

Subject and Date	Character of Experiment	Period of Disease	Average Rectal Temp. C.	Average Pulse Rate	Average Respiratory Quotient	Indirect Calorimetry Average per Hour		Per Cent. Divergence of Direct Cal. from Indirect Calories		Per Cent. Rise Above Normal Aver. Basal of 34.7 Cal. per Sq. M.	Per Cent. Rise Above Patient's Own Basal Metabolism	Day of Basal Determination Used for Comparison
						Cal. per Kg.	Cal. per Sq. M.	According to Rectal Temp.	According to Surface Temp.			
Morris S. 25	9.0 gm. N..........	Continued temperature	40.0	99	.77	1.70	51.42	— 5	......	+48		
Oct. 24, 1913	Basal.............	Continued temperature	39.5	101	.84	1.70	51.27	— 2	......	....	— 0.3	Oct. 24.
28	115.0 gm. glucose..	Continued temperature	39.2	111	.93	1.64	49.35	+ 1	......	....	+ 0.6	Oct. 29.
29	Basal.............	Continued temperature	39.6	106	.79	1.62	49.04	— 1	......	+41		
31	10.3 gm. N.........	Early steep curve.......	39.1	100	.84	1.68	50.24	—11	......	....	+ 2.4	Oct. 29.
Nov. 3	Restless...........	Early steep curve.......	38.9	108	.80	1.66	49.46	— 9	......	+43		
5	Basal.............	Early steep curve.......	38.1	106	.81	1.60	47.31	— 4	......	+36		
17	Basal.............	First Relapse Ascending temperature	38.7	108	.81	1.44	42.52	— 1	+ 1	+23		
18	Basal.............	Ascending temperature	39.9	118	.83	1.53	45.38	+ 1	— 1	+31		
24	Basal.............	Continued temperature	39.4	124	.76	1.79	52.69	—17	......	+52		
25	8.7 gm. N..........	Continued temperature	39.2	118	.81	1.84	54.17	— 8	......	....	+ 3.9	Av. Nov. 24 and 26.
26	Basal.............	Early steep curve.......	39.1	118	.76	1.78	51.60	—17	......	+49		
Dec. 12	10.6 gm. N.........	7th day, normal temp.	37.0	94	.84	1.45	42.89	— 9	— 8	....	+18.1	Dec. 13.
13	Basal.............	8th day, normal temp.	37.0	83	.82	1.23	36.33	+ 0	+ 4	+ 5		
15	115 gm. glucose....	10th day, normal temp.	37.2	95	1.01	1.36	40.07	— 8	—11	....	+ 3.7	Dec. 16.
16	Basal.............	11th day, normal temp.	37.3	88	.88	1.31	38.67	— 2	+ 0	+11		
19	115 gm. glucose....	Second Relapse Ascending temperature	39.4	116	.93	1.60	47.46	+ 2	— 4	....	+ 1.3	Dec. 20.
20	Basal.............	Early steep curve.......	39.6	113	.78	1.61	46.83	— 1	— 2	+35		
22	115 gm. glucose....	Early steep curve.......	39.2	116	.94	1.55	46.04	+11	+10	....	+ 0.7	Av. Dec. 20 and 26.
23	Basal.............	Early steep curve.......	38.3	101	.79	1.50	44.57	+ 5	+ 2	+28		
Jan. 2, 1914	Basal.............	8th day, normal temp.	37.0	75	.81	1.17	34.93	+ 3	+ 5	+ 1		
27	Basal.............	33d day, normal temp.	36.9	66	.82	1.10	34.30	+ 7	+ 4	—1		
Dec. 17, 1914	Basal.............	One year later..........	36.8	63	.81	1.10	35.16	+ 0	......	+ 1		
18	9.6 gm. N..........	One year later..........	36.9	68	.88	1.16	37.44	+ 4	......	....	+ 6.5	Dec. 17, 1914.

TABLE 7.—Summary of Clinical Calorimetry in Typhoid Fever—(*Continued*)

Subject and Date	Character of Experiment	Period of Disease	Average Rectal Temp. C.	Average Pulse Rate	Average Respiratory Quotient	Indirect Calorimetry Average per Hour		Per Cent. Divergence of Direct Cal. from Indirect Calories		Per Cent. Rise Above Normal Aver. Basal of 34.7 Cal. per Sq. M.	Per Cent. Rise Above Patient's Own Basal Metabolism	Day of Basal Determination Used for Comparison
						Cal. per Kg.	Cal. per Sq. M.	According to Rectal Temp.	According to Surface Temp.			
Charles F. Nov. 10, 1913	Basal.............	Ascending temperature	39.1	78	.79	1.44	45.26	— 7	— 6	+30		
11	6.6 gm. N..........	Ascending temperature	39.2	82	.84	1.50	47.28	+ 1	— 2	....	+ 4.5	Nov. 10, 1913.
14	115 gm. glucose....	Continued temperature	39.5	97	.90	1.54	48.12	— 8	— 6	....	+ 1.3	Nov. 15.
15	Basal.............	Continued temperature	39.9	89	.78	1.52	47.49	—10	— 9	+37		
29	Basal.............	Early steep curve.......	36.9	83	.82	1.29	38.54	+ 2	......	+11		
Dec. 8	10.5 gm. N.........	7th day, normal temp.	36.8	77	.92	1.38	41.53	— 3	......	....	+15.5	Dec. 9.
9	Basal.............	8th day, normal temp.	36.8	78	.92	1.20	35.96	+ 3	......	+ 4		
10	115 gm. glucose....	9th day, normal temp.	36.7	80	1.00	1.33	40.18	—10	......	....	+11.7	Dec. 9.
26	Basal............	25th day, normal temp.	36.9	76	.85	1.17	36.36	+ 8	+ 1	+ 5		
31	Basal.............	30th day, normal temp.	37.0	80	.79	1.21	37.52	— 5	— 8	+ 8		
Howard F. Nov. 7, 1914	Basal..............	Ascending temperature	39.7	103	78	1.85	49.93	—10	— 3	+44		
12	6.5 gm. N..........	Continued temperature	39.9	105	.81	1.93	51.15	— 2	+ 1	....	+ 8.9	Nov. 13.
13	Basal.............	Continued temperature	39.8	107	.78	1.78	47.00	— 2	— 2	+35		
20	Basal.............	Continued temperature	39.2	99	.76	1.76	45.52	— 2	— 0	+31		
Dec. 1	115 gm. glucose....	5th day, normal temp.	37.0	97	.97	1.54	40.10	— 8	......	....	+14.1	Dec. 2.
2	Basal.............	6th day, normal temp.	36.9	76	.94	1.35	35.15	+ 6	......	+ 1		
5	10.2 gm. N.........	9th day, normal temp.	37.1	91	.85	1.79	47.25	— 2	......	....	+24.3	Dec. 6.
6	Basal.............	10th day, normal temp.	37.0	75	.96	1.45	38.03	+ 0	......	+10		
18	Basal.............	22d day,* normal temp.	37.2	107	.84	1.60	43.28	+ 1	+ 1	+25		
30	Basal.............	34th day,*normal temp.	37.2	108	.82	1.52	42.08	— 2	+ [illegible]	+21		

Karl S. Jan. 5, 1914	Basal..............	Continued temperature	39.9	112	.76	1.74	54.01	— 3	— 6	+56		
6	10.5 gm. N.........	Continued temperature	39.9	108	.82	1.88	57.93	+ 3	+ 6	....	+ 7.3	Jan. 5.
16	Basal.............	Late steep curve......	38,2	95	.79	1.57	46.76	......	......	+35		
19	Basal.............	1st day, normal temp.	36.5	77	.88	1.19	35.83	......	......	+ 3		
21	10.0 gm. N.........	3d day, normal temp.	36.5	72	.90	1.33	40.06	......	......	....	+21.1	Jan. 22.
22	Basal.............	4th day, normal temp.	36.5	61	.89	1.10	33.08	......	......	— 5		
Feb. 6	Basal.............	18th day, normal temp.	36.9	81	.81	1.33	40.51	— 8	— 6	+17		
7	9.6 gm. N..........	19th day, normal temp.	37.0	90	.90	1.37	42.08	— 5	+ 2	....	+ 3.9	Feb. 6.
Thomas B. Oct. 15, 1913	Basal..............	Late steep curve........	37.1	85	82	1.07	36.54	— 6	......	+ 5		
21	Basal.............	1st day, normal temp.	36.9	78	.92	0.93	31.57	+ 2	......	— 9		
Richard T. Oct. 18, 1913	Basal..............	Early steep curve.......	39.0	90	.81	1.69	45.44	— 4	......	+31		
20	Basal.............	Early steep curve.......	38.3	93	.85	1.62	43.32	— 5	......	+25		
Anton K. Oct. 16, 1913	Basal..............	Late steep curve........	37.1	79	.86	1.27	38.26	+ 5	......	+10		
Rose G. Nov. 22, 1913	Basal..............	25th day, normal temp.	37.1	78	.87	1.71	43.13	+ 1	......	+24		
Edward B. Oct. 23, 1914	Basal.............	First relapse: early steep curve	38.5	116	.79	1.43	44.33	— 7	......	+28		
26	79 gm. olive oil...	First relapse: late steep curve	37.9	118	.81	1.33	41.50	— 2	......	....	+ 3.4	Oct. 27.
27	Basal.............	First relapse: late steep curve	37.6	107	.79	1.29	40.15	— 7	......	+16		
Nov. 4	Basal.............	4th day, normal temp.	37.2	104	.85	1.22	38.39	— 3	......	+12		
6	Basal.............	Second relapse: ascending temp.	39.3	124	.82	1.31	41.47	— 5	......	+20		
10	Basal (irrational)	Second relapse: continued temp.	40.3	141	.76	1.67	52.18	— 6	......	+50		
John K. Dec. 15, 1914	Basal.............	Continued temperature	39.2	63	.77	1.49	48.18	— 4	......	+39		

* Excluded from averages on account of rapid, irregular and weak heart action.

amounts of heat. Therefore the law of the conservation of energy applies to fever patients.

The rectal temperature does not always give an accurate indication of the average change in body temperature, and better results are often obtained by well covered surface thermometers.

The basal heat production rises and falls in a curve roughly parallel with the temperature. At the height of the fever it averages about 40 per cent. above the normal but in some cases rises to more than 50 per cent. above the normal.

The specific dynamic action of protein and carbohydrate is much smaller in the febrile period of typhoid than in health and in some cases seems to be absent. In convalescence it may be greater than normal.

In a majority of cases a rise in temperature is accompanied by an increasing heat production and an increasing heat elimination.

Typhoid patients can store body fat on an abundant diet while losing body weight and body protein. Loss in weight and loss of protein are usually though not necessarily parallel.

There is a toxic destruction of protein in typhoid fever. This is shown by the fact that patients have a distinctly negative nitrogen balance on a diet which contains more than enough calories to cover the heat production.

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